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The flowers and buds of the Glazed Mallee *Eucalyptus tenera*, which is endemic to Western Australia. Found in Tarin Rock Nature Reserve.

Photo: Jolanda Keeble

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HONEYEATERS TAKING MARRI SAP ON GOOSEBERRY HILL

By MICHAEL BROOKER
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On the morning of 18 January 2016 my attention was drawn to a congregation of honeyeaters in a thicket of Marri *Corymbia calophylla* saplings on the lower scarp on Gooseberry Hill, Western Australia. This was unusual as nothing was flowering in the immediate vicinity. Four species were present – about 20 New Holland Honeyeaters *Phylidonyris novaehollandiae*, 10 Brown Honeyeaters *Lichmera indistincta*, four Singing Honeyeaters *Lichenostomus virescens* and two Gilbert's Honeyeaters *Melithreptus chloropsis*. All of them were probing small pits on the trunks of Marri saplings and were behaving as if they were at a rich nectar source with numerous inter- and intra-specific chases. The pits were on the trunks of saplings with dbh < 10cm, which had grown there since a very hot wildfire in March 2007. The pits had formed when small branchlets had died and fallen off, and after consultation with several botanists and foresters (Alex George *pers. comm.*), the term 'gum pocket' was coined to describe them (Figure 1). Marris, like other bloodwoods, exude gum when a branch is shed or the trunk is wounded. Most pockets were moist and the birds were inserting their bills as they would into a blossom, suggesting they were licking sap rather than taking dried exudate. Subsequently, I observed a Western Spinebill *Acanthorhynchus superciliosus* probing gum pockets, which means that the entire suite of honeyeaters I would expect in this area at this time of the year was involved (Brooker 2001) (Figure 2). Western Thornbills *Acanthiza inornata* and bull ants also showed an interest in the pockets. No probing by honeyeaters was seen after 26 February 2016.

Figure 1. Marri saplings on Gooseberry Hill showing gum pockets on the trunks.

Antecedent seasonal conditions may have stressed the saplings at this time as the rainfall for 2015 was 607mm versus an average of 796mm, and for spring 108mm versus an average of 162mm. Only 16mm was recorded in December and none fell the following month until 26 January. In addition, December and January each had a number of very hot days – seven in December and 11 days in January had maximum temperatures above 35 degrees. It is not known, however, if this stress would have enhanced the production of gum pockets or the availability of exudate. There were few sources of nectar on the area in January except for a few blossoms on some of the Wandoos *Eucalyptus wandoo*. By June, some of the Marri saplings in the thicket had died or were resprouting from their trunks after losing their canopy leaves.

Some of the gum pockets had been enlarged and some trunks had small (10 x 30mm) grooves cut into the bark. The honeyeaters probed these entrances, but I did not see a honeyeater making them.

It is not clear whether these were rare events or had previously been either under-recorded or mis-interpreted as foraging for

Figure 2a. New Holland Honeyeater probing a gum pocket in January 2016.

Figure 2b. Gilbert's Honeyeater probing a gum pocket in January 2016.

Figure 2c. Brown Honeyeater probing a gum pocket in January 2016.

arthropods. I have recorded this behaviour only once before – a Singing Honeyeater was probing a Marri sapling in January 1993 – but I could have overlooked it previously as I did not make many visits in late summer, especially if conditions were dry. Harry Recher has observed similar behaviour (Recher and Davis 1998, *pers. comm.*). According to the Handbook (Higgins *et al.* 2001), only two of the five species involved here (i.e. New Holland and Gilbert's Honeyeaters) are said to take dietary items other than nectar, fruit and invertebrates.

Paton (1980) drew attention to the fact that manna, honeydew and lerps are important in the diet of honeyeaters. My observations suggest that, in some circumstances, sap from Marris could also be important when other foods are scarce.

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SWAN COASTAL PLAIN STUDIES: STATUS OF THE SUBSPECIES OF *GREVILLEA CURVILOBA* MCGILLIVRAY (PROTEACEAE): A CRITICALLY ENDANGERED PLANT

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ABSTRACT

The two subspecies of *Grevillea curviloba*, *G. curviloba* subspecies *curviloba* and *G. curviloba* subspecies *incurva*, which are both listed as critically endangered species, are re-assessed and reduced to synonomy under the species. The species remains as critically endangered because of its very limited range, continuing threats and small population sizes.

INTRODUCTION

Detailed field studies on the Swan Coastal Plain over the past 30 years (e.g. Gibson *et al.* 1994), have uncovered many taxonomic issues in the local flora. This has resulted in the segregation and formal description of several new taxa, e.g. Keighery & Keighery (2017). This paper deals with the status of two critically endangered subspecies of *Grevillea curviloba*.

The genus *Grevillea* was reviewed by McGillivray (1986) who created a new name, *Grevillea curviloba* for the species previously known as *Grevillea vestita* var. *angustata* Meisn. This taxon was at that stage widely cultivated under the name *Grevillea biternata* Meisn. (McGillivray & Makinson 1993).

Subsequent to McGillivray's (1986) and McGillivray & Makinson's (1993) revisions, Olde & Marriott (1993) noted that *Grevillea curviloba* contained two visually distinct morphological entities occurring in geographically distinct homogeneous populations. As a consequence they divided *Grevillea curviloba* into two subspecies; *Grevillea*

curviloba subsp. *curviloba* and *Grevillea curviloba* subsp. *incurva* Olde and Marriott, the latter being the commonly cultivated form (Olde and Marriott 1995). These subspecies were maintained in Makinson (2000).

Olde and Marriott (1993) differentiated the subspecies on leaf characters as described in Table 1.

Both subspecies were subsequently declared rare under the Western Australian *Wildlife Conservation Act* 1950 (Smith 2015), with both subspecies ranked as critically endangered under the World Conservation Union IUCN red list catagories (IUCN 2001). Both subspecies are ranked as endangered under the *Commonwealth Environmental Protection and Biodiversity Conservation Act* 1999. In 2000 (English & Phillimore 2000 and Phillimore & English 2000) interim recovery plans for both taxa were produced.

CURRENT TAXONOMIC STATUS

Olde and Marriott (1993) considered that subspecies *curviloba* was confined to a small area around Bullsbrook, whereas subspecies *incurva* occurred north of this area around Muchea. This distribution was followed in Makinson (2000). However, while undertaking recovery actions for these taxa since early 2000 it has been noted that both the geographic and morphological separation is blurred and the two subspecies are often difficult to separate and that a taxonomic review of the species was needed.

DELINEATION OF THE SUBSPECIES

The rank of subspecies is used in plants for populations that normally occupy a distinct and separated portion of the species range. They should be morpho-

Table 1

Grevillea curviloba* subspecies *curviloba	***Grevillea curviloba* subspecies *incurva***
Leaves pinnatifid to occasionally subpinnatisect	Leaves secund- subpinnatisect
Sinuses broad	Sinuses on or near midrib
Leaf underside clearly exposed	Underside not visible or very inconspicuous
Primary leaf lobes >1.5 mm wide	Primary leaf lobes 0.8–1.2 mm wide
Primary leaf lobes obovate-cuneate	Primary leaf lobes narrow linear
Lobes flat	Lobes ascending
Secondary divisions mostly lacking	Secondary divisions present

logically and/or genetically distinct but still capable of interbreeding when they are brought together (Hamilton & Reichard, 1992). Therefore, we consider if the subspecies in *Grevillea curviloba* are deserving of this rank under the headings of geographical separation, morphology and genetics.

Geography

While Olde and Marriott originally considered the two subspecies separated by approximately 6–8 kilometres, subsequent collecting has blurred this separation (Figure 1). Collections at the Western Australian Herbarium (PERTH) of subspecies *curviloba* are largely southern, from Muchea, Bullsbrook, west of Pearce, Vines Bush Forever Site 23 and Maralla Road Nature Reserve (in Bush Forever Site 300), while subspecies *incurva* is recorded from Muchea north to Timaru Nature Reserve (south of Gingin). The two subspecies meet in the Muchea area and a clear geographic separation of the two subspecies is no longer

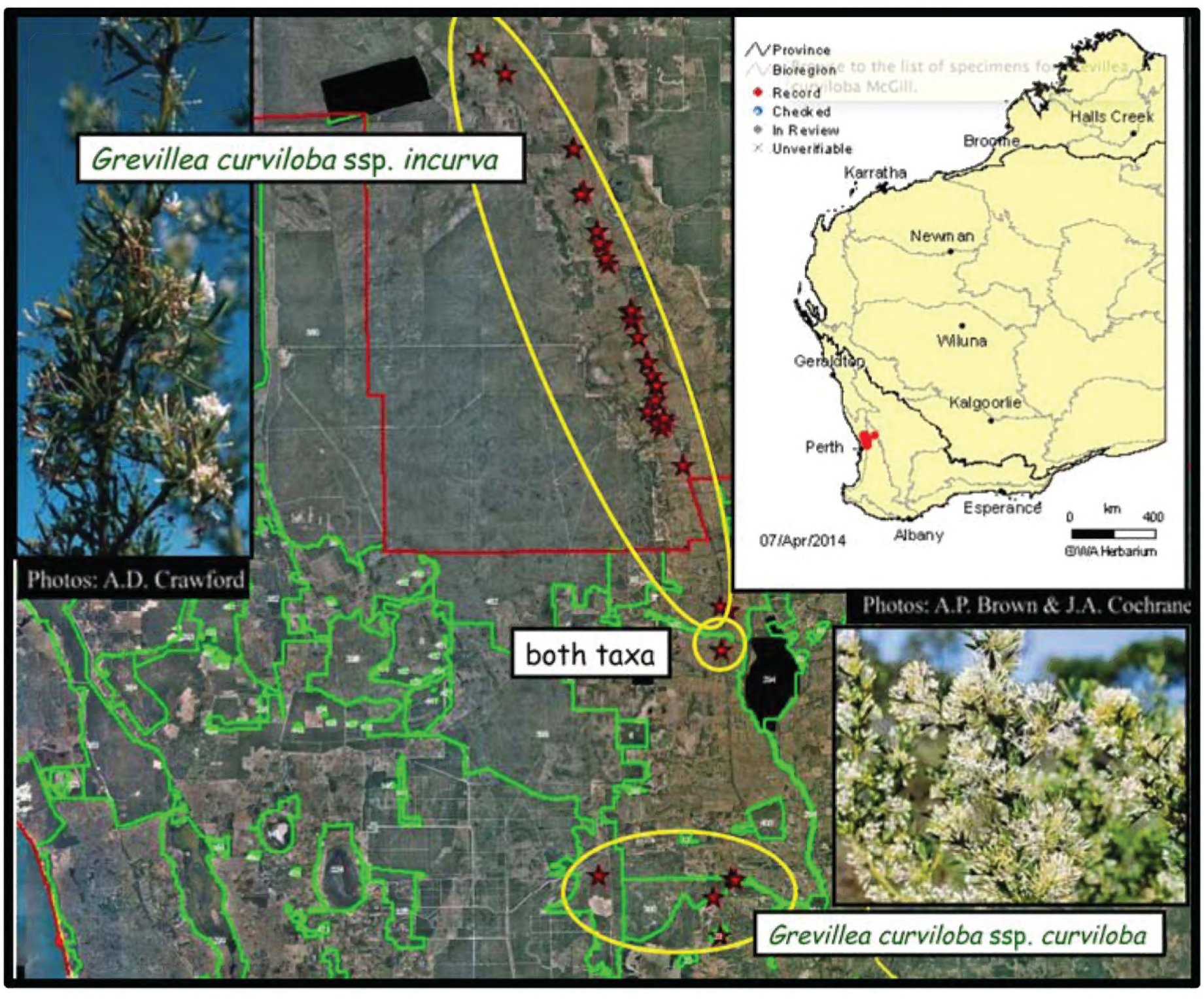

Figure1. Distribution of *Grevillea curviloba* at State and local level. Yellow lines mark outline of the range of the subspecies. Green outlines areas of remnant bushland.

apparent (Figure 1), but still within the requirements of sub-specific separation.

Morphology

To check allocation of plants to the subspecies we collected mature leaves from widely separated plants from Maralla Road Reserve (4 plants), Vines Bush Forever Site (12 plants), Muchea Nature Reserve (23 plants), adjacent road verge in Muchea Townsite (10 plants), Timaru Nature Reserve (4 plants) and a road verge population west of Pearce Airforce Base (13 plants).

At the type locality for sub-species *incurva* in and around Muchea Nature Reserve there were individuals with the leaf morphology (Figure 2) of either subspecies. For example, at Muchea individual clumps have leaves that are hard, sub-pinnatisect, with very inrolled margins with the midrib just visible, lobes that are 1 mm wide, narrow linear, strongly ascending with secondary divisions. These plants correspond to subspecies *incurva* (Figure 2, h, i and j). Other individuals have soft pinnatifid leaves with a broad sinus, lobes up to 3.3 mm wide, cuneate, flat with few secondary divisions (Figure 2 c, d, e, and f). Other plants were intermediate (Figure 2 a, b and g).

This variation is reflected in specimens at PERTH where, depending on the plant collected, voucher material from Muchea has been assigned to either subspecies (B. Keighery

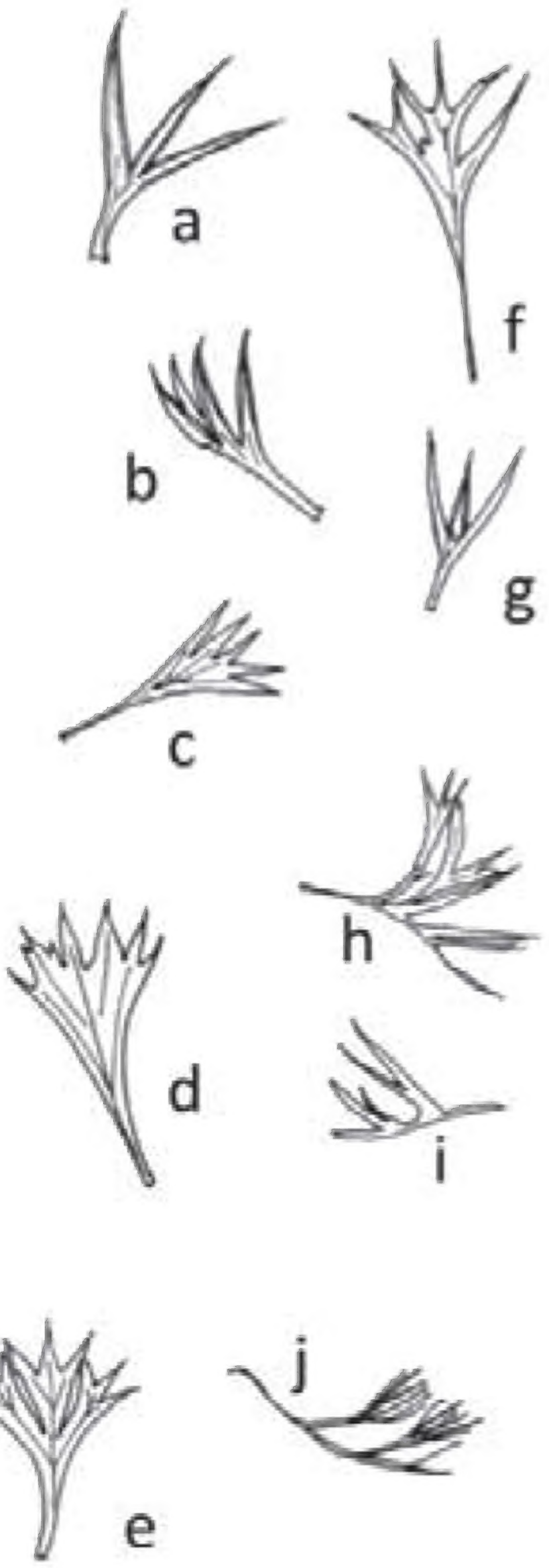

Figure 2. Leaf tracings of *Grevillea curviloba* clones from Muchea Nature Reserve

2394, 2395, 2396 and 2398 to *Grevillea curviloba* subsp. *curviloba* and B. Keighery 2397, 2399, 2400 and 2401 to *Grevillea curviloba* subsp. *incurva*). Hence the type population of *Grevillea curviloba* subsp. *incurva* consists of individuals that can be assigned to either subspecies, rather than the homogeneous populations suggested by Olde & Marriott (1993).

Similar variation was documented at the Vines, road verge populations west of Pearce and at Saw Pit Gully (Ellenbrook) not cited above. These populations, being much smaller, were less variable than the Muchea population but contained both leaf types. Maralla Road Nature Reserve contained only the leaf morphology of subspecies *curviloba* and the northernmost population at Timaru Nature Reserve was the only site to consistently show the leaf morphology of a single subspecies, subspecies *incurva*. So, there is some separation on a geographic basis with northern populations being more likely to contain leaf types of subspecies *incurva*. However, most populations have a mixture of leaf types.

Genetic Data

The basis for this leaf variation within and between populations is partially explained by Nistleberger (2006), who undertook a genetic study of this species based on suggestions by the senior author that populations appeared to show clonal reproduction and very low seed set.

Both subspecies exhibit a peculiar growth habit, whereby a plant spreads across the soil surface via a series of horizontal, above-ground stems and then sends up vertical flowering branches (a feature repeated in cultivation). Nistleberger (2006) observed that the horizontal ground spreading stems cannot establish roots but there are also underground rhizomatous stem structures that generate roots, and thus new plants, especially after fire. In sandy soils these structures can lead to the formation of large clones of apparently separate individuals.

The degree of clonality within G. *curviloba* varies considerably from population to population, from the southernmost population in Maralla Road Nature Reserve, which was found to be highly clonal, the 17 "individuals" consisting of just two genotypes, which explains the lack of variation in leaf morphology observed. This is especially noted as this was the only natural population with the broad leaf type of subspecies *curviloba*.

Plants at Muchea were much more variable, being both clonal and sexual in the reserve, but on the road-verges north of Muchea Nature Reserve plants were apparently of mixed origins as this sub-population had a high genetic diversity between plants and were the only plants to set viable seed in Nistleberger's study. Clonality is poorly

expressed at the northernmost site at Timaru where most plants occur on skeletal red loams on ironstone. Although plants produce large clumps via the above ground stems, the shallow soil over the ironstone hardpan means they cannot produce the underground stems and were killed by a wildfire after sampling (authors' personal monitoring) and regenerated from seed.

Nistleberger (2006) obtained genetic data for 11 populations across the range of *Grevillea curviloba* that showed that, while there was genetic diversity between populations, this did not reflect the allocation of plants or populations to subspecies based on morphology. For example populations from north and south of Muchea were closer to each other than their allocation to the different subspecies indicated. The study showed an absence of structure in genetic differentiation occurring within G. *curviloba* between the two subspecies and no clear relationship exists between genetic variation and the two subspecies.

CONCLUSIONS

Vegetative reproduction as the major reproductive strategy has been reported previously for a number of Western Australian *Grevillea* species including the critically endangered G. *althoferorum* (Burne *et al.* 2003), the common G. *synapheae* (Burne *et al.* 2003), and the closely related G. *vestita* which is capable of clonal growth via suckering (McGillivray 1993).

The most extreme example of the loss of sexual reproduction is in G. *infecunda*, a narrow endemic of Victoria which is a suckering species which flowers prolifically, but has never been recorded to produce seed (Kimpton *et al.* 2002).

The division of G. *curviloba* into the two subspecies *curviloba* and *incurva* was initially based on morphological variations noted on leaf structure (i.e. ascending, broad leaf lobes for subsp. *curviloba*, and incurved, narrow leaf lobes for subsp. *incurva*). However, many species of *Grevillea* show considerable variation in leaf morphology within a population. For example, the closely related and partially clonal *Grevillea vestita* also shows considerable variation in leaf morphology both within and between populations. A clone of this taxon at Bold Park (voucher: Bold Park, G. & B. Keighery s.n., 2-Aug.-1999) was for many years allocated either to *Grevillea curviloba* or an unnamed variant of *Grevillea vestita* (Botanic Gardens and Parks Authority, 2000), until shown to be a local variant that occurs with typical *Grevillea vestita*.

Another example is *Grevillea infecunda*, which has leaf morphology that is consistent within each population but which differs between populations (Kimpton *et al.* 2002). This appears to be the case for

Grevillea curviloba where there is as much or more variation within a population in leaf morphology as there is between populations. The narrow-leaved form in the northern portion of the species' range (Muchea and perhaps Timaru) appears to be less clonal, produces viable seed and has thus been widely cultivated. This has led to the perception that the species contained several distinct leaf forms deserving of formal recognition.

Therefore, it appears that variations in leaf morphology are a "normal" population feature of this species. The clonal habit of populations of this species can produce stands with similar apparently fixed leaf morphologies, but the leaf types typically do not occur in homogeneous populations, nor are they geographically separated or genetically distinctive. They therefore do not meet the criteria for recognition as separate subspecies based on leaf morphology and should not be given formal taxonomic recognition. However, the forms are distinctive in cultivation and could be given cultivar names.

There are cases where clonal plants form pure populations that are geographically distinct and are treated as separate management units for conservation purposes without formal taxonomic recognition (for example *Acacia anomala*, Coates 2000). *Grevillea curviloba* as a species occurs over a very short range in a highly fragmented landscape and contains a number of populations with distinctive forms of reproduction. These populations should be treated as part of a conservation plan for the entire species, which remains as critically endangered.

TAXONOMY

Grevillea curviloba McGillivray, *New Names in Grevillea (Proteaceae)* 4 (1986).

Based on *Grevillea vestita* var. *angustata* Meisn. Meisner, C.D.F. (1845) Proteaceae in J.G.C. Lehmann, *Plantae Preissianae* 1 (4): 549. Type: Swan River, Drummond (first collection) 1839, n. 622, iso: MEL(!).

Synonyms:

Grevillea diversifolia var. *rigida* Meisn, in Meisner, C.D.F. (1856) Proteaceae in A. de Candolle, *Prodromus Systematis Naturalis Regni Vegetabilis* 14 (1): 368. Type: Drummond (fourth collection) 1848, n. 286, Isol: MEL(!).

Grevillea curviloba subsp. *incurva* Olde & Marriott *Nuytsia* 9: 243 (1993) Type: Muchea, W.A., 26 Sept. 1992, P.M. Olde 92/108. Holo: NSW (!).

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FIRST AUSTRALIAN SPECIMEN OF FAIRY PITTA (*PITTA NYMPHA*) WITH NOTES ON ITS DISTRIBUTION AND MIGRATION

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INTRODUCTION

On 7 February 2019 a pitta was found by the duty manager of Matso's Broome Brewery after hitting a window. It was placed in a box and shortly after recovered and was released at the same site. It was observed near the same site over two days, but on 9 February was found dead in gardens next door to the brewery and had probably been attacked by a cat as it had an injury to head and neck. It was still fresh and appeared to have died that day. The specimen was frozen and brought to the Western Australian Museum (Welshpool) by George Swann on 15 February 2019. The specimen was then prepared into a study skin (registered number A41184) and its identification confirmed as a Fairy Pitta *Pitta nympha* Temminck & Schlegel, 1850.

DESCRIPTION OF THE SPECIMEN

Details of the bird are as follows:

Juvenile female; total length 174 mm; weight 48 g (with no body or subcutaneous fat); exposed culmen 21 mm; entire culmen 26.5 mm; bill width 8.1 mm; bill depth 8.0 mm; wing 119 mm; tail 34 mm; tarsus 39 mm; middle toe and claw 28 mm. Iris dark brown; bill dull black; mouth flesh; legs pinkish.

Forehead and sides of crown chestnut brown; centre of crown black, narrow at front and broadening in centre of crown to become a broad black patch and joined on nape by black mask on sides of head. Some feathers on nape with black edges giving a scaled appearance. Long narrow creamy buff supercilium from nostril to nape. Lores, narrow chin line, cheeks, ear coverts and hindneck black (forming a black mask and contrasting with pale buff supercilium). Mantle dull olive green grading on back and scapulars to bright dark green. Rump and uppertail coverts glistening turquoise blue. Tail black broadly tipped (7–10 mm) with dark green. Lesser upperwing coverts glistening

turquoise blue (the feathers with black bases and broad blue tips, forming a conspicuous glistening blue patch on the shoulder); median and greater coverts dark green. Primaries black with prominent wing-bar formed by white spots across both webs of inner primaries and on outer web of outer feathers except the outermost. See Figure 1.

Chin and throat white. Breast and flanks dull olive buff grading to buff on lower breast and sides of belly. Centre of belly to undertail coverts bright red.

Underwing coverts and axillaries black. Undertail black. See Figure 2.

DISTRIBUTION, GEOGRAPHIC VARIATION, STATUS AND MIGRATION

The Fairy Pitta forms a superspecies with the Indian Pitta *Pitta brachyura*, the Blue-winged Pitta *P. moluccensis* and

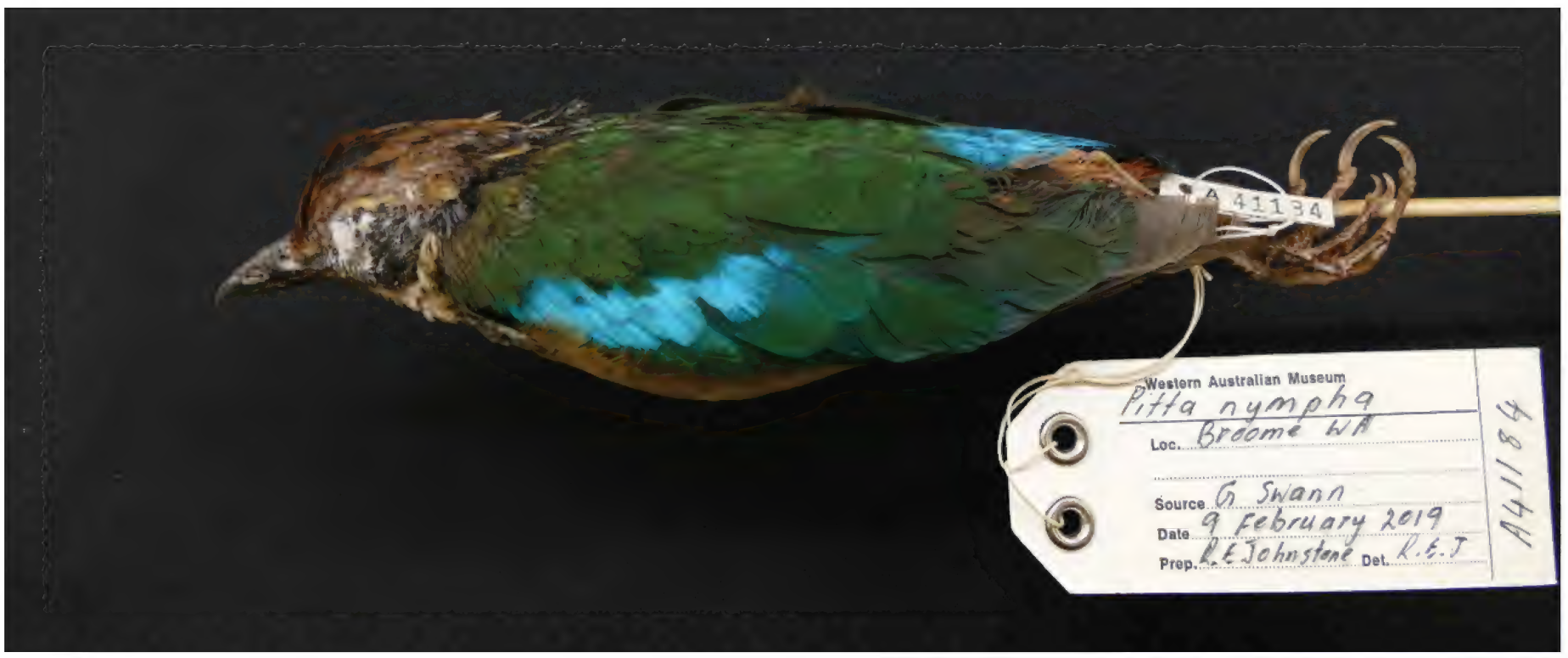

Figure 1. Fairy Pitta *Pitta nympha* A41184 – lateral view.

Figure 2. Fairy Pitta *Pitta nympha* A41184 – ventral view.

the Mangrove Pitta *P. megarhyncha* and formerly treated as conspecific with the Indian Pitta but differs in morphology, plumage and calls.

The Fairy Pitta is one of the rarest of the pittas and was listed globally as Vulnerable by Birdlife International (Collar *et al.* 1994 and by del Hoyo *et al.* 2003) with its overall status listed now as rare and seriously threatened in most of its breeding range due to deforestation. It is a long-distance migrant breeding in Japan (May to July), South Korea (May to June), mainland China and Taiwan and wintering mainly in Borneo and southern China. The most northern populations in Japan leaving their breeding quarters in August–September and returning in mid-May. Movements are poorly understood, but most birds from Japan and Korea appear to move south or south-west during the non-breeding season, through eastern China and Indochina then across the sea to northern Borneo. Birds have been recorded in Hong Kong during the northern winter (January–February). Hundreds of Fairy Pittas (up to 200 a day) were recorded in Taiwan each spring during the 1980s (Severinghaus *et al.* 1991) indicating a flyway through that region. Migrants have been recorded in Annam, Vietnam in April that were probably birds returning to their breeding grounds on a northerly migration route from Borneo. Biometrics, especially size, show that specimens collected in eastern China originated in Korea and Japan (Mees 1977). There are no current records from the Philippines or Wallacea, however judging from the fact that there are now two records from northern Western Australia it is very possible that over-shooting migrants could obviously reach both these areas.

The first observation of this species in Australia was in Derby on 13 December 2007 when a bird was photographed in a town garden and remained there between 13–15 December (M. Carter 2008). Judging from photographs the Derby bird was an adult.

The Broome bird weighed only 48 g, had a bony keel, no subcutaneous or body fat, and at about half the weight of many migrants was positively emaciated. To give some idea of this, the weight of a female collected in Kalimantan on 25 November as a newly arrived migrant weighed 63 g and the weight of birds from Taiwan ranged from 67.5–155.0 g.

Of interest is that this may have been the second pitta to have died at this location. In December 2018, approximately six weeks prior, a similar pitta had flown into a ceiling fan, was picked up dead and buried in the garden. A later attempt to locate the bird's remains to confirm its identification was not successful.

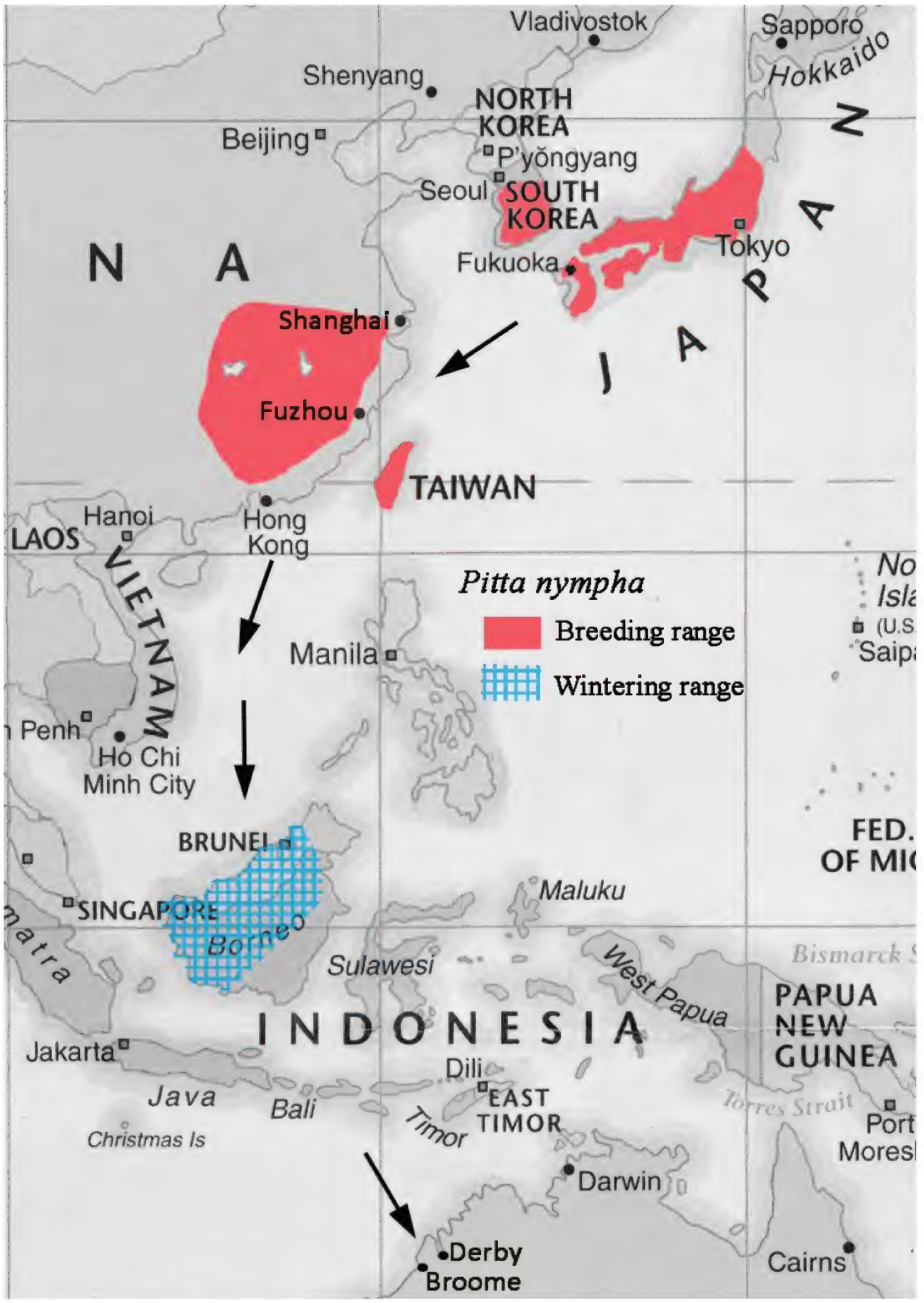

Figure 3. Map showing the distribution of *Pitta nympha* breeding and wintering ranges.

HABITAT, FOOD AND CALL

In Japan and South Korea, the Fairy Pitta occurs mainly in lowland and foothill evergreen forests with dense undergrowth including bamboo thickets and often near streams. The clearing of lowland forest is the main threat especially in China also lowland fires and hunting appear to be the main causes of this species decline.

Birds forage mainly on ground and food includes beetles, ants, centipedes, snails and worms (del Hoyo *et al.* 2003). Its call is similar

to that of the Blue-winged Pitta a clear double whistle, comprising two disyllabic notes, 'kwah-he kwa-wu', but longer and slower.

WEATHER

Only one tropical cyclone occurred over the western, North Pacific Ocean and in the South China Sea in January 2019. Tropical Cyclone "Pabuk" formed as a tropical depression over the southern part of the South China Sea on 31 December 2018 and tracked west-southwest towards South Vietnam. It then turned to move westwards on 2 January 2019 and intensified into a severe tropical storm on the morning of the 4 January. "Pabuk" then moved across the Malay Peninsula and weakened into a tropical storm before petering out in the Bay of Bengal. Apart from this, western Nusa Tenggara (eastern Indonesia) experienced very strong winds and torrential rain during January 2019. It is certainly possible that tropical Cyclone "Pabuk" could have played a part in driving the Broome bird so far south. Cyclones often drive migratory birds well off course and far beyond normal range limits. Migrating birds from southern China crossing the South China Sea to winter in Borneo would no doubt have been affected by this cyclone. The strong winds in eastern Indonesia during this period may also have forced this bird further south.

CONCLUSION

This record also highlights the value of specimens in gaining information on these Asian migrants including details of sex, age, condition, morphology and thus their region of origin.

ACKNOWLEDGEMENTS

We thank Clare and Grant Morton of Broome for finding the bird and for their interest and help in securing this valuable specimen for the Western Australian Museum. We also thank Kim Sarti for photographing the specimen, help with the manuscript and preparing the distribution map.

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A RARE SUBSPECIES OF *APIUM PROSTRATUM* L. (APIACEAE) FROM WESTERN AUSTRALIA

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ABSTRACT

A new subspecies of *Apium prostratum*, *A. prostratum* subsp. *phillipii* is described. The subspecies is confined to the Porongurup Range, N.E. of Albany.

INTRODUCTION

The genus *Apium* L. (Apiaceae) is a cosmopolitan genus, including the widely cultivated *Apium graveolens* (Celery) and was revised for Australasia by Short (1979). In this revision Short separated a number of forms of the widespread and variable species *Apium prostratum* into three subspecies and two varieties based largely on leaf morphology.

Apium prostratum subspecies *prostratum* is the most widespread ranging from Australia to New Zealand. This subspecies has two varieties, variety *filiforme* (Headland Sea Celery) which is a squat plant with broad rounded leaflets (Figure 1, a) and variety *prostratum* (Narrow Leafed Sea Celery) which has slender leaves (Figure 1, b). *Apium prostratum* subspecies *denticulata* (which has leaves with small teeth around the margins) is confined to the Chatham Islands. *Apium prostratum* subspecies *howense* (which has very short finely divided leaves) is confined to Lord Howe Island.

He foreshadowed the naming of a fourth subspecies (listed in his paper as subspecies "A") based on a single collection of a branch with a mature leaf made in 1867 without fruit from the Porongurup Range in Western Australia (Figure 1,c). Short was unsure if this collection was an Apium species, but he thought it would be part of the *Apium prostratum* complex.

Subsequently the author surveyed the Porongurup Range (Keighery 1999), rediscovered plants of this form and made collections in flower and fruit showing that the plants are definitely members of the genus *Apium*.

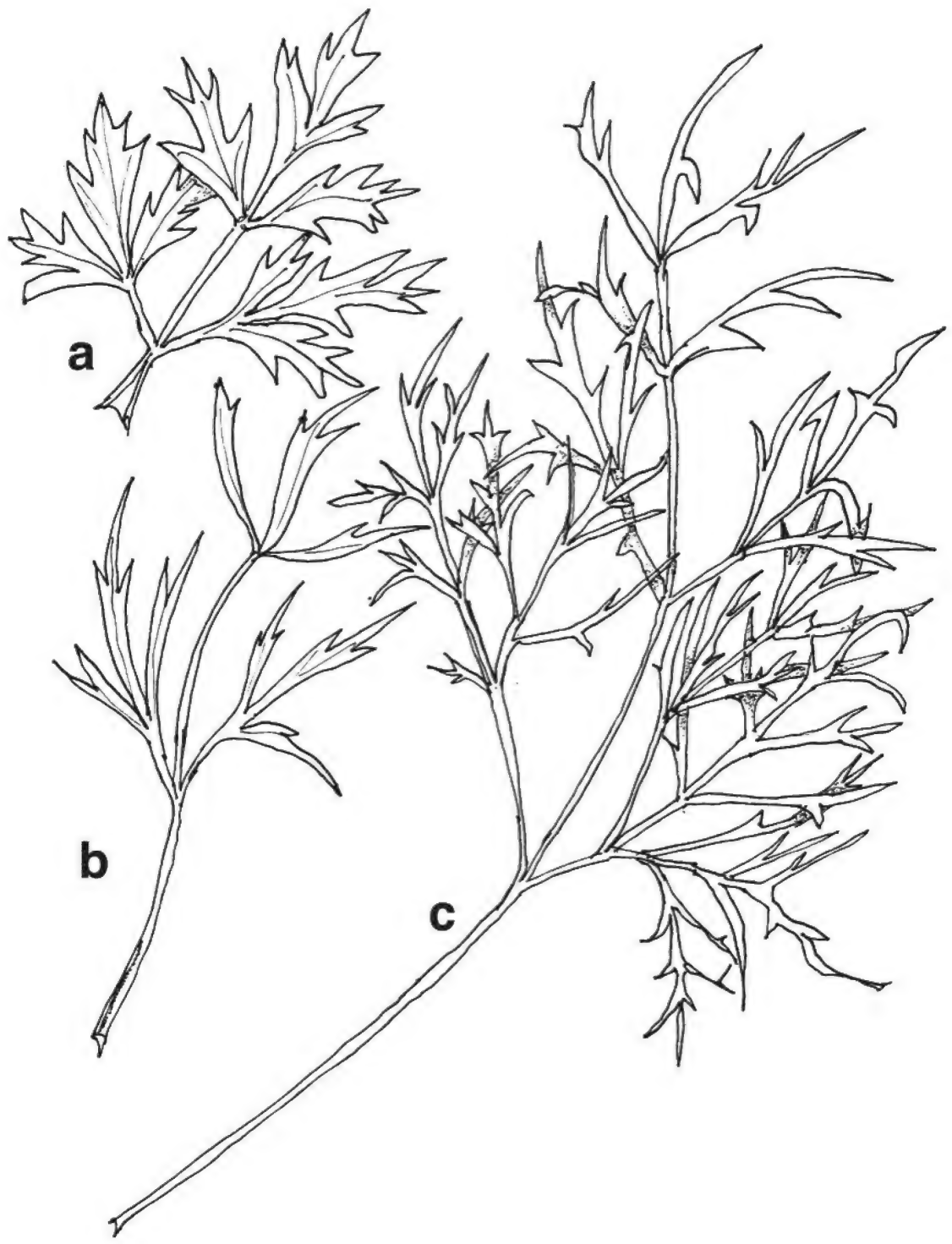

Figure 1. Leaves of the members of *Apium prostratum* present in Western Australia. Leaves chosen are located just below an inflorescence, not basal leaves. a: subspecies *prostratum* variety *filiforme* (Keighery 8734, PERTH); b: subspecies *prostratum* variety *prostratum* (B/G Keighery 2187, PERTH); c: subspecies *phillipii* (MEL 508361).

As noted by Short (1979) the subspecies differs from *Apium prostratum* subspecies *prostratum* (the only member of the species complex in Western Australia) in the very large highly divided leaves with up to 150 segments per leaf (Figure 1, c), but also the slender erect habit of the adult plant and erect inflorescences when seen in the field.

The populations in the Porongurup Range are listed as Threatened Flora under the Western Australian Wildlife Conservation Act as *Apium prostratum* subsp. Porongurup Range (G.J. Keighery 8631), Smith (2017). This paper provides a valid name for this taxon.

TAXONOMY

Apium prostratum Labill. ex Vent. subspecies **phillipii** G.J. Keighery subsp. nov.

Typus: Christmas creek, Porongurup Range, 01-Dec.-1986, G.J. Keighery 8631(PERTH 01217216 Holotype, 01217215 Isotype).

Differt a Apium prostratae inflorescentis erecta, folia umbellas compositas opposita 12–15 cm longa: folia primaria et sepae secundaria, ultimis quaternariis segmentis 100–150 per folium.

It differs from typical *Apium prostratum* in the slender erect habit of the adult plant bearing the inflorescence, and the very

large leaves up to 15 centimetres long, with up to 150 quaternary segments per leaf.

Description

Glabrous terrestrial **perennial herb** from a tuberous rootstock (can die back to this rootstock in very dry years). Inflorescence axis annual, erect or spreading 30–70 cm long, produced during spring and summer, yellowing and lost during autumn, plant exists as a 4-7-(10) leafed rosette during winter. **Basal leaves** from rootstock, 20–40 cm long, divided up to quaternary order as in the leaves opposite the umbels. **Leaves** opposite compound umbels to 15 cm long, leaflets primary and secondary 5–11 in all, primary segments pinnatifid, narrow linear to lanceolate, elliptic-obovate, entire, quaternary segments present, greater than 150 per leaf. **Compound umbels** pedunculate, 0.2 mm long, rays 5–7 per inflorescence. **Petals** white, ovate, 1–1.5 mm long, c. 0.5 mm wide, constricted at base, apex acute. **Stamens** are approximately the length of the petals, filaments with purple anthers. **Ovary** glabrous, stylopodium disc like, style equaling length of stylopodium, c. 0.4 mm long. **Schizocarp** obovate to orbicular, 1.5–2.5 mm long, 1.5–2 mm broad, carphophore shortly bifid, mericarps in radial longitudinal section flat on commissural surface, hexagonal in transection, almost covered by prominent corky ribs with seed wall barely apparent between the ribs; vittae large, solitary in the intervals, 2 on the commissure.

Specimens examined: Porongurup, Anon (prob. F. Mueller), Oct.-1867 (MEL 503681, 503682 and 503694), Unnamed Creek, near Cockatoo Creek, Porongurup Range, 20-Nov.-1986, Keighery 8873, Millinup Pass, Porongurup Range, 23-Jan.-1990, L. Anderson s.n. (PERTH), Millinup Pass, Porongurup Range, 13-April-1989, G.J. Keighery 11985 (PERTH), Bolganup Creek, Porongurup Range, 03- Feb.-1993, C.J. Robinson 1078 (PERTH).

Common name. Fine Leaved Sea Celery.

Distribution. Known only from the Porongurup Range, 30 km. NE of Albany.

Habitat. Found along winter and spring flowing creeklines under Karri (*Eucalyptus diversicolor*) tall forest on red-brown loams over granite.

Flowering and fruiting time. Recorded in flower between November and February. Mature fruits were found in April.

Discussion. This subspecies corresponds to ssp. "A" in Short (1979). The subspecies is one of a number of usually coastal taxa, which have disjunct populations in the Porongurup Range. These include *Acacia heteroclita* subsp. *valida* and an unnamed form of *Lepidosperma gladiatum* (Keighery 1999). There are also a series of localized endemics on the granites of the Range.

Conservation Status. This species is declared rare flora under the Western Australian Wildlife Protection Act (Smith 2017).

Etymology. The epithet honours Phillip Short, Botanist, who first recognized this taxon as distinct and who has made major contributions to the taxonomy of *Apium* in Australia.

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FLORA OF THE SWAN COASTAL PLAINS FOOTHILLS 3: VASCULAR FLORA OF KORIJEKUP CONSERVATION PARK, HARVEY

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ABSTRACT

Korijekup Conservation Park, the largest remnant of the Swan Coastal Plain Foothills (Ridge Hill Shelf) vegetation south of Perth has a vascular flora of 346 species (293 native species and 53 weeds), including 6 species only recorded for the Swan Coastal Plain Bioregion from this locality. This unique area is a valley system, which contains geomorphic elements of the Darling Plateau, Darling Escarpment of the Jarrah Forest IBRA Region and the Foothills of the Swan Coastal Plain.

INTRODUCTION

The Foothills (Ridge Hill Shelf) of the Swan Coastal Plain IBRA region (Macarthur & Bettenay, 1960 and Department of Environment and Water Resources, 2007) are the gentle slopes of colluvial sands, loams and clays with intrusions of gravel that may be at surface or depth that derive from the Darling Plateau and abut the granitic slopes of the Darling Escarpment. The Foothills have very high levels of clearing for agriculture being of low relief, relatively fertile and better drained than the adjacent Pinjarra Plain. It is estimated that the Foothills are approximately 97% cleared, making any remnant of high regional conservation value. This is the third of a series of papers describing the vascular flora of the foothills (Keighery & Keighery, 2105 and 2017).

Korijekup Conservation Park (Reserve 21587, 54 hectares), located on the eastern side of Harvey town-site (Figure 1), is the largest remnant of Foothills vegetation remaining south of Perth. Like Bancell Road Reserve east of Pinjarra (Keighery & Keighery, 2017), this very significant remnant was not mentioned in the System Six

Report (Department of Environment and Conservation, 1983). Fortunately when the area was proposed to be subdivided for housing, the then Harvey District Manager recognising the significance of the landform commissioned a report on the values of the area (Keighery, 1995), which also highlighted its significance. These actions began the process leading to its declaration as a Conservation Reserve.

SURVEY METHOD

Survey work in was performed over many flowering seasons from 1995 to 2012, with a major effort in 2004 when the Bushland Plant Survey Program of the Wildflower Society of Western Australian (Inc.) established 10 permanent quadrats in the reserve. This survey was undertaken in conjunction with the Bush Plan project of the then Department of Environmental Protection.

Opportunistic plant collections, that is, collections made outside set quadrats, were made during foot traverse at various times of the year. Voucher collections are deposited in PERTH.

Nomenclature generally follows that used that used in FloraBase (Western Australian Herbarium 1998-), or in the most recent revisions. Conservation status of the flora is assigned in Smith (2017) as per Table 1.

GEOMORPHOLOGY AND SOILS

Macarthur & Bettenay (1960) place the Reserve in their Ridge Hill Shelf System of the Swan Coastal Plain. The geological survey report by Wilde & Walker (1983) indicates that the situation is more complex, with the area being a "hybrid" of the Jarrah

Table 1. Categories of Conservation Listed Flora according to the degree of perceived threat.

Category	Definition
P1 (Poorly known Flora)	Taxa with less than 5 populations, which are under threat
P2 (Poorly known Flora)	Taxa with less than 5 populations, at least some of which are not believed to be under immediate threat
P3 (Poorly known Flora)	Taxa with several populations (more than 5), at least some of which are not believed to be under immediate threat
P4 (Rare Taxa)	Taxa which are considered to be adequately surveyed and which while being rare are not currently threatened by any identifiable factors

Forest with areas of tertiary laterites of the Darling Plateau, areas of Darling Escarpment with exposures of gneiss and quartzite on the hills and the Guildford formation of the Ridge Hill Shelf with colluviums of sands and clays in the drainage courses and alluvium on the slopes and valleys where it is secondarily lateritized.

The area is a valley system, which contains portions of the Darling Plateau, Darling Escarpment of the Jarrah Forest IBRA Region and the Ridge Hill Shelf of the Swan Coastal Plain (Department of Environment and Water Resources, 2007).

The rgserve is effectively much larger and habitat diverse than it appears from the air (Figures 1 and 2). The northern two thirds of the reserve is made up of slopes and narrow ridge tops with several west facing incised valleys. The southern third of the reserve is even more complex (Figure 2). Area 1 is an undulating lateritic upland area; Area 2 a deeply incised south facing valley with a variety of soils, Area 3 an east facing gneiss ridge; and Area 4 has exposed granite.

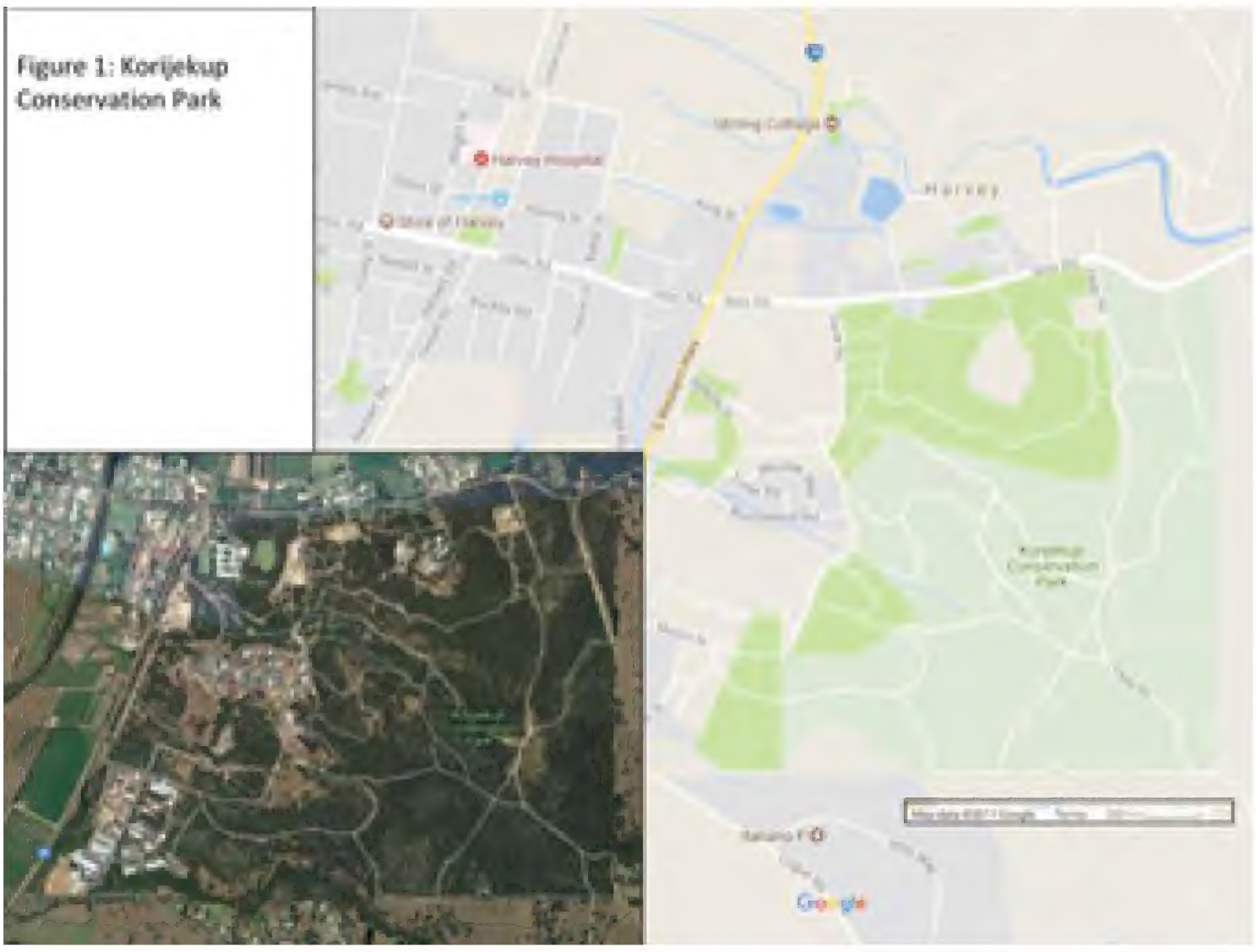

Figure 1. Korijekup Conservation Park.

Figure 2. Landscape features of Korijekup Conservation Park.

VEGETATION

Vegetation Associations

Smith (1974) maps the reserve as Jarrah (*Eucalyptus marginata*)/ Marri (*Corymbia calophylla*) open forest, including this in his Darling Plateau forests and woodlands. However, the vegetation is placed in the Forrestfield complex by Heddle *et al.*, (1980), which occurs along the foothills of the Darling Scarp. Beard (1981) placed the reserve in his Ridge Hill Shelf Subsystem, comprising Jarrah-Marri Forest with an understory tree layer of *Banksia grandis* and *Allocasuarina fraseriana*.

The reserve contains a mosaic of Jarrah woodland on the eastern lateritic spurs (including Area 1), with combinations of Jarrah/ Marri and Mountain Marri (*Corymbia haematoxylon*) on the slopes and valleys in Area 3. Wandoo (*Eucalyptus wandoo*) woodland occurs in patches on the granitic SW portion of the reserve (westward facing slopes Area 2 and Area 4), which grade into heath on the shallow soils around the outcropping gneiss or granite. There is an area of Darling Range Ghost Gum (*Eucalyptus laeliae*) woodland on the lower slopes of Area 2. These units can be referenced to the 10

quadrats located in 2004 (Table 2) and the habitats identified in Table 3.

The reserve contains the largest area of Jarrah, Marri, Mountain Marri, Darling Range Ghost Gum and Wando woodlands with an intact understorey known in the Foothills.

Area 2, the south facing steeply incised valley is also of particular interest as there are few such naturally vegetated valleys remaining in the Foothills. The community of *Poa homomalla* Very Open Grassland and *Lomandra pauciflora* Open Herbland and *Adiantum aethiopicum* Open Fernland is more typical of the wet forests.

Swan coastal Plain Floristic Community Types

Korijekup was not included in the study of the floristics of the Swan Coastal Plain, Gibson *et al.*, (1994), nor was it included in the study of the Darling Scarp by Markey (1997). However, it was included in the study of the floristics of the Whicher Scarp (Keighery *et al.*, 2008). In this study all sites at Korijekup formed a separate group (group D) at a high level.

The Korijekup group is reasonably species diverse having an average native taxa per quadrat of 55 (range 45–69), and an average weed frequency of seven (range 3–17). This group was included in the Whicher Scarp study to investigate the level of similarity between the vegetation of the Foothills and the Darling Scarp to that of the Whicher Scarp. This area was chosen as it was the closest substantive public owned bushland area to the Whicher Scarp that shared a series of landform, soils and vegetation features with the Whicher Scarp. These shared characteristics are listed below.

- Landform – the location in a similar position and profile in relation to the Swan Coastal Plain as the Whicher Scarp, i.e. Swan Coastal Plain facing slopes of moderate grade.
- Soils – sequence of sands, laterites and quartzite/ laterite.
- Vegetation – woodlands dominated by Marri, Jarrah and *Corymbia haematoxylon* and combinations of these.

To delineate regional patterning in this group a further analysis should be done with quadrats located in the Foothills and along the Darling Scarp from Gibson *et al.* (1994), Markey (1997), DEP (1996) and DEC (2007) in a similar manner to that done by Markey. The work for DEC (2007) has established a series of quadrats to supplement those used by Markey. Markey's study area extended from Walyunga National Park to North Dandalup, additional quadrats being located along the Darling Scarp and associated Foothills, in the north from the Moore River to Walyunga National Park and, in the south, from Pinjarra to Harvey. It is expected that many

of the plant communities identified in such a study would delineate a large number of restricted floristic groups as the Foothills vegetation is so complex (reflecting the complexity of soils and landform) and so heavily cleared. Even at a structural level displayed in Table 2, we have not recorded the Darling Range Ghost Gum woodland (E1, KOJE10) anywhere else on the Swan Coastal Plain, nor the complexity of Jarrah woodlands.

FLORA

Total Flora

A vascular flora list of 346 species (293 natives, 53 weeds) was recorded from the reserve. This is the largest number of taxa recorded for any of the reserves reported on in this series (Keighery & Keighery unpub.

Table 2. Vegetation descriptions for the 10 permanently located sampling quadrats. Quadrat code and habitat group are given in the left hand column.

Em (KOJE01)	*Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* Open Forest over *Xanthorrhoea gracilis* Open Low Heath over *Tetrarrhena laevis* and **Briza maxima* Very Open Grassland and *Conostylis aculeata* and *Stylidium amoenum* var. *amoenum* Very Open Herbland and *Tetraria capillaris* and *Lepidosperma tenue* Open Sedgeland
Em (KOJE02)	*Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* Open Forest over *Xanthorrhoea preissii* Shrubland over mixed Very Open Herbland and mixed Very Open Sedgeland
Em (KOJE03)	*Eucalyptus marginata* subsp. *marginata* Woodland over *Daviesia cordata* Open Shrubland over *Xanthorrhoea preissii, Xanthorrhoea gracilis* and *Acacia lateriticola* Open Low Heath over mixed Very Open Herbland and *Cyathochaeta avenacea* and *Tetraria octandra* Very Open Sedgeland
Ew (KOJE04)	*Eucalyptus wandoo* and *Corymbia calophylla* Open Forest over *Xanthorrhoea preissii, Hibbertia hypericoides* and *Phyllanthus calycinus* Open Heath over *Microlaena stipoides* Very Open Grassland and mixed Open Herbland and *Mesomelaena tetragona* Very Open Sedgeland
Ch/Em (KOJE05)	*Eucalyptus marginata* subsp. *marginata* Woodland over *Corymbia haematoxylon* Open Low Woodland over *Xanthorrhoea acanthostachya* and *Xanthorrhoea gracilis* Shrubland over *Lepidosperma gracile* and *Lepidosperma squamatum* Open Sedgeland

Ch/Em (KOJE06)	*Eucalyptus marginata* subsp. *marginata*, *Corymbia calophylla* and *Corymbia haematoxylon* Open Forest over *Xanthorrhoea acanthostachya* Tall Shrubland over *Hibbertia hypericoides* and *Dryandra lindleyana* Low Shrubland over **Hypochaeris glabra*, *Lomandra purpurea*, *Scaevola calliptera* and *Drosera pallida* Herbland and *Lepidosperma leptostachyum* Very Open Sedgeland
Em (KOJE07)	*Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* Open Forest over *Banksia grandis* Low Woodland over *Xanthorrhoea acanthostachya* Shrubland over *Hibbertia hypericoides* Closed Low Heath over *Pentapeltis peltigera* and *Phlebocarya ciliata* Very Open Herbland and *Lepidosperma squamatum* and *Lepidosperma gracile* Open Sedgeland
El (KOJE08)	*Corymbia calophylla* Open Forest over *Eucalyptus laeliae* and *Eucalyptus marginata* subsp. *marginata* Open Low Woodland over *Hakea amplexicaulis* Open Shrubland over *Hibbertia hypericoides*, *Xanthorrhoea preissii* and *Dryandra lindleyana* Open Low Heath over **Briza maxima* and *Microlaena stipoides* Very Open Grassland
Cr (KOJE09)	*Xanthorrhoea preissii* Open Tall Shrubland over *Hakea amplexicaulis* Open Shrubland over *Xanthorrhoea gracilis* Low Shrubland over **Briza maxima* and *Poa homomalla* Very Open Grassland and *Lomandra pauciflora* Open Herbland and *Adiantum aethiopicum* Open Fernland
El (KOJE10)	*Eucalyptus laeliae*, *Eucalyptus wandoo*, *Eucalyptus marginata* subsp. *marginata* and *Eucalyptus calophylla* Open Forest over *Xanthorrhoea preissii* Shrubland over **Briza maxima* Very Open Grassland and *Lagenophora huegelii*, **Hypochaeris glabra* and *Daucus glochidiatus* Herbland

data, Keighery & Keighery, 2015 and 2017).

Species Richness

The most species rich families are the Asparagaceae 26 species, Fabaceae 39 species (including 3 weeds), Poaceae 31 species (18 Weeds) and the Proteaceae 24 species. This is slightly unusual in not having the Myrtaceae (16, with 1 weed), Orchidaceae (18, with 1 weed) or Cyperaceae (18, with 1 weed) in the top four families. However, it does reflect the normally most dominant families of the south Western flora.

The most species rich genera are *Acacia* (13 species), *Stylidium* (12) and *Lomandra* (10). The high diversity of *Lomandra* species is typical of the Jarrah forest on the western edge of the Darling Plateau, reflecting the mixed nature of the site

Significant Species

These are briefly described below.

Conservation Listed Species

Stylidium korijekup and *Caladenia uliginosa* subsp. *patula*

Given the rich flora and location on the Ridge Hill Shelf it is somewhat surprising that only two taxa present in Korijekup are listed as rare. *Stylidium korijekup*, originally first collected and recognised in the reserve (Wedge *et al.*, 2007), now has two populations one here and one in the Whicher Scarp and is listed as Priority 2. *Caladenia uliginosa* subsp. *patula*, a poorly known taxa with only a few known populations along the Darling Escarpment and near Boyanup and is listed as Priority 1. This is the only record of this subspecies from the Swan Coastal Plain.

Significant records

Arthropodium curvipes is a wheatbelt species occurring here on the granites. This record is a considerable disjunction from the nearest record in FloraBase from Dryandra Forest, north of Narrogin.

Thysanotus pseudojunceus, scattered populations from Cape Riche to Korijekup, only record of this species from the Swan Coastal Plain.

Hibbertia mylnei extends from Eneabba to the Whicher Scarp, occasionally recorded on the Swan Coastal Plain at Ellis Road, Kalamunda and Harvey.

Eucalyptus laeliae, confined to the Darling Escarpment between Darlington and Capel, extends onto the Plain where there are lateritic spurs at Ellis Valley, Gobby Road and Harvey.

Marianthus candidus and *Isopogon sphaerocephalus* are normally components of the Jarrah Forest, scattered records from the Swan Coastal Plain from Ellis Road (Darlington) and north of Harvey. Similar is *Billardiera floribunda*, but this is also recorded from the Swan Coastal Plain below the Whicher Scarp south of Busselton (Keighery *et al.*, 2008).

Stylidium plantagineum, an outlying population of this species, common between Albany and Stirling Ranges, scattered populations at Collie, Nannup and Walpole. This is the only record of this species from the Swan Coastal Plain.

Xanthorrhoea acanthostachya, a poorly known species, confined to the Darling Scarp from Mogumber to Capel, this is the only record of this species from the Swan Coastal Plain.

There are also eight taxa found here that are only known from the Swan Coastal Plain from the ridge hill shelf: *Acacia latericola*, *Acacia celastrifolia*, *Drosera marchantii* subsp. *marchantii*, *Chorizema rhombeum*, *Dryandra bipinnatifida* subsp. *multifida*, *Verticordia pennigera*, *Pimelea lehmanniana* and *Pimelea sylvestris*.

There are two co-occurring varieties of *Acacia pulchella*, var.

pulchella and var. *glaberrima* in the reserve, which do not seem to hybridize and have largely separate flowering periods, indicating they may deserve higher taxonomic status.

Weeds

Areas of the reserve and adjacent areas have been subject to gross disturbance, being totally cleared, used as a refuse tip, for garden refuse dumping and enrichment plantings around the old Forest buildings. Although many of these species are still confined to these very disturbed areas, some such as *Rhamnus alaternus* and *Acacia longifolia* are spreading into the reserve and pose a future risk to the values of the reserve. Consolidation of the boundaries of the reserve and rehabilitation of the disturbed areas would greatly lessen the weed risk.

Saffron Thistle, *Carthamus lanatus*, a declared species (Keighery & Longman, 2004) is present on roadsides, tracks and disturbed land adjacent to the Reserve, but does not seem to have invaded the bushland.

Other major weeds present in the reserve are the bulbous weeds *Watsonia marginate* and *Watsonia meriana* var. *bulbillifera* and the perennial grasses *Eragrostis curvula* and *Ehrharta calycina*.

DISCUSSION

We consider that over 90% of the known flora has been recorded from the reserve. Korijekup is the largest and most diverse of all the Foothills reserves south of Perth. It is also unique in preserving part of the valley systems that are a combination of the intersection of the Jarrah Forest and Swan Coastal Plain.

The flora is diverse and contains numerous taxa that like Bancell Road Reserve (Keighery & Keighery, 2017) are rarely recorded from the Swan Coastal Plain.

ACKNOWLEDGEMENTS

The assistance and companionship of the over 70 Volunteers who helped establish the 10 quadrats in the reserve in 2004 is gratefully acknowledged and all are individually listed in Keighery *et al.* (2008).

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Table 3. Flora of Korijekup Conservation Park

KEY

Cr	Creekline
Ch/Em	Mountain Marri (*Corymbia haematoxylon*) and Jarrah (*Eucalyptus marginata*)
Em	Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*)
Ew	Wandoo (*Eucalyptus wandoo*)
El	Darling Range Ghost Gum (*Eucalyptus laeliae*)
D	Disturbed (Tracks, partially cleared areas, fencelines)
CC	Conservation code

Family/Scientific Name	Cr	Em	Ch/Em	Ew	El	D	CC
Adiantaceae							
Adiantum aethiopicum				+	+		
Cheilanthes austrotenuifolia	+			+			
Amaranthaceae							
Ptilotus manglesii			+		+		
Ptilotus stirlingii		+			+		
Amaryllidaceae							
*Leucojum aestivum						+	
Anarthriaceae							
Anarthria gracilis			+				
Anarthria prolifera			+				
Lyginia barbata			+				
Asparagaceae							
Arthropodium capillipes		+	+				
Arthropodium curvipes				+	+		
Chamaescilla corymbosa var. corymbosa		+	+	+	+		
Laxmannia ramosa subsp. ramosa				+			
Laxmannia sessiliflora subsp. australis		+					
Lomandra brittanii			+		+		
Lomandra caespitosa		+		+	+		
Lomandra hermaphrodita		+					
Lomandra micrantha		+	+	+			
Lomandra nigricans		+	+				
Lomandra pauciflora					+		
Lomandra preissii		+	+	+	+		
Lomandra purpurea					+		
Lomandra sericea		+	+		+		
Lomandra sonderi					+		
Sowerbaea laxiflora				+	+		

Family/Scientific Name	Cr	Em	Ch/Em	Ew	El	D	CC
Thysanotus dichotomus		+					
Thysanotus manglesianus		+		+	+		
Thysanotus multiflorus		+	+		+		
Thysanotus patersonii					+		
Thysanotus pseudojunceus					+		
Thysanotus sparteus			+				
Thysanotus thyrsoideus		+		+			
Apiaceae							
Actinotus glomeratus			+		+		
Daucus glochidiatus		+	+	+	+		
Eryngium pinnatifidum subsp. pinnatifidum				+			
Homalosciadium homalocarpum		+		+			
Xanthosia candida					+		
Xanthosia ciliata		+	+				
Xanthosia huegelii		+	+		+		
Araliaceae							
Hydrocotyle callicarpa		+		+	+		
Hydrocotyle hispidula			+				
Trachymene pilosa		+	+		+		
Asteraceae							
*Carthamus lanatus						+	
Craspedia variabilis		+	+				
*Dimorphotheca ecklonis						+	
Euchiton collinus		+	+		+		
*Hypochaeris glabra		+	+	+	+	+	
Lagenifera huegelii		+	+	+	+		
Millotia tenuifolia		+	+				
Olearia paucidentata				+			
*Ozothamnus diosmifolius						+	
Pithocarpa pulchella			+				
Podolepis gracilis			+				
Podolepis lessonii		+					
Podotheca angustifolia		+		+	+		
Pterochaeta paniculata			+				
Quinetia urvillei				+			
Senecio diaschides		+	+	+	+		
Senecio hispidulus				+	+		
Siloxerus humifusus				+	+		
*Sonchus oleraceus	+			+			
Trichocline spathulata		+		+	+		
*Tolpis barbata						+	
*Urospermum picroides						+	
Waitzia citrina		+		+			

Family/Scientific Name	Cr	Em	Ch/Em	Ew	El	D	CC
Boryaceae							
Borya sphaerocephala				+			
Campanulaceae							
*Wahlenbergia capensis						+	
Wahlenbergia gracilenta		+	+		+		
Caryophyllaceae							
*Cerastium glomeratum				+		+	
*Petrorhagia velutina				+		+	
*Silene nocturna				+		+	
Casuarinaceae							
Allocasuarina humilis		+					
Centrolepidaceae							
Aphelia cyperoides				+			
Centrolepis aristata				+			
Colchicaceae							
Burchardia congesta		+	+	+	+		
Crassulaceae							
Crassula colorata var. tuberculata		+					
Crassula peduncularis					+		
Convolvulaceae							
*Ipomoea indica						+	
Cyperaceae							
Carex appressa	+						
Cyathochaeta avenacea			+	+	+		
*Cyperus tenellus	+			+			
Isolepis cernua	+						
Isolepis marginata						+	
Isolepis oldfieldiana	+						
Lepidosperma gracile		+	+				
Lepidosperma leptostachyum		+	+		+		
Lepidosperma scabrum			+				
Lepidosperma squamatum		+	+				
Lepidosperma tenue		+	+	+			
Lepidosperma tetraquetrum	+						
Mesomelaena graciliceps		+	+				
Mesomelaena tetragona		+	+	+	+		
Schoenus unispiculatus				+			
Tetraria capillaris		+	+				
Tetraria octandra		+	+	+	+		
Tricostularia neesii		+					

Family/Scientific Name	Cr	Em	Ch/Em	Ew	El	D	CC
Dasypogonaceae							
Calectasia narragara		+					
Kingia australis		+					
Dennstaedtiaceae							
Pteridium esculentum subsp. esculentum	+						
Dilleniaceae							
Hibbertia acerosa		+	+				
Hibbertia commutata		+	+	+			
Hibbertia cunninghamii		+	+		+		
Hibbertia hypericoides		+	+	+	+		
Hibbertia mylnei		+					
Hibbertia racemosa		+	+				
Hibbertia vaginata	+	+					
Droseraceae							
Drosera bulbosa subsp. bulbosa				+			
Drosera erythrorhiza	+	+		+	+		
Drosera glanduligera				+			
Drosera marchantii subsp. marchantii				+	+		
Drosera menziesii subsp. penicillaris				+			
Drosera paleacea subsp. paleacea					+		
Drosera pallida							
Drosera porrecta	+						
Elaeocarpaceae							
Platytheca galioides	+	+			+		
Tetratheca piliferum	+						
Ericaceae							
Andersonia sprengelioides				+			
Astroloma ciliatum	+	+		+	+		
Astroloma pallidum	+	+					
Conostephium pendulum		+					
Conostephium preissii		+					
Leucopogon capitellatus		+	+		+		
Leucopogon propinquum		+					
Leucopogon pulchellus		+					
Lysinema ciliatum			+				
Styphelia tenuiflora		+	+				
Fabaceae							
Acacia applanata			+				
Acacia celastrifolia					+		
Acacia dentifera		+					
Acacia extensa		+					
Acacia huegelii		+					

Family/Scientific Name	Cr	Em	Ch/Em	Ew	El	D	CC
Acacia latericola		+	+		+		
*Acacia longifolia						+	
Acacia microbotrya						+	
Acacia myrtifolia	+	+		+			
Acacia nervosa		+	+				
Acacia obovata			+		+		
Acacia pulchella var. glaberrima		+	+				
Acacia pulchella var. pulchella		+	+				
Acacia saligna				+			
Acacia stenoptera					+		
Acacia urophylla				+	+		
Bossiaea angustifolia		+	+	+			
Bossiaea eriocarpa					+		
Bossiaea ornata			+				
Chorizema ilicifolium					+		
Chorizema rhombeum			+				
Daviesia cordata			+				
Daviesia decurrens				+			
Daviesia divaricata	+						
Daviesia horrida	+						
Daviesia preissii					+		
*Dolichos lignosus	+					+	
Gastrolobium capitatum	+	+					
Gompholobium capitatum			+				
Gompholobium knightianum	+	+					
Gompholobium marginatum	+			+	+		
Gompholobium polymorphum			+	+			
Gompholobium preissii	+				+		
Hovea chorizemifolia	+						
Hovea trisperma subsp. grandiflora	+		+		+		
Jacksonia furcellata			+				
Jacksonia sternbergiana			+				
Kennedia coccinea			+		+		
Kennedia prostrata	+						
Labichea punctata	+						
*Lathyrus tingitanus				+		+	
*Lotus angustissimus						+	
Mirbelia dilatata	+						
Sphaerolobium medium	+		+		+		
*Trifolium campestre				+		+	
Gentianaceae							
*Centaurium erythraea			+	+			
*Cicendia filiformis				+			
Geraniaceae							
Pelargonium littorale			+		+		

Family/Scientific Name	Cr	Em	Ch/Em	Ew	El	D	CC
Goodeniaceae							
Dampiera alata		+	+	+	+		
Dampiera linearis		+	+				
Dampiera trigona				+			
Goodenia caerulea			+				
Goodenia eatoniae				+			
Goodenia fasciculata				+			
Lechenaultia biloba		+	+				
Scaevola calliptera		+					
Scaevola repens		+					
Haemodoraceae							
Anigozanthos manglesii			+				
Conostylis aculeata subsp. preissii		+					
Conostylis setigera subsp. setigera		+					
Haemodorum discolor				+			
Haemodorum laxum		+	+				
Haemodorum spicatum		+			+		
Phlebocarya ciliatum		+					
Tribonanthes australis				+			
Hemerocallidaceae							
Agrostocrinum hirsutum		+	+		+		
Caesia micrantha		+	+	+	+		
Caesia occidentalis				+			
Dianella revoluta var. revoluta				+	+		
Stypandra glauca		+		+			
Tricoryne elatior		+	+	+			
Tricoryne humilis					+		
Hypoxidaceae							
Hypoxis glabella var. glabella				+			
Iridaceae							
*Freesia alba x leichtlinii				+		+	
*Gladiolus angustus		+			+		
*Iris ungicularis	+						
Orthrosanthus laxus var. laxus				+			
Patersonia juncea		+					
Patersonia occidentalis var. occidentalis		+		+	+		
*Romulea rosea			+	+	+	+	
*Watsonia marginata			+	+			
*Watsonia meriana var. bulbillifera			+	+			
Juncaceae							
*Juncus bufonius					+		
*Juncus capitatus					+		

Family/Scientific Name	Cr	Em	Ch/Em	Ew	El	D	CC
Juncus holoschoenus	+						
*Juncus microcephalus					+		
Juncus subsecundus					+		
Luzula meridionalis		+	+	+	+		
Lamiaceae							
Hemiandra pungens var. pungens		+					
*Lavandula stoechadis						+	
Lauraceae							
Cassytha racemosa		+	+		+		
Linaceae							
*Linum trigynum			+		+	+	
Lobeliaceae							
Isotoma hypocrateriformis			+				
Lobelia anceps	+			+			
Lobelia rhombifolia			+	+			
Lobelia tenuior		+	+		+		
Loganiaceae							
Logania serpyllifolia subsp. serpyllifolia			+				
Phyllangium paradoxum				+	+		
Loranthaceae							
Nuytsia floribunda		+					
Myrtaceae							
Baeckea camphorosmae		+					
Calothamnus hirsutus		+					
Corymbia calophylla		+					
Corymbia haematoxylon		+	+				
Eucalyptus laeliae						+	
Eucalyptus marginata		+	+			+	
Eucalyptus rudis subsp. rudis	+						
Eucalyptus wandoo				+	+		
Hypocalymma robustum		+	+				
Kunzea glabrescens		+					
Kunzea micrantha				+			
Kunzea recurva	+						
*Leptospermum laevigatum			+			+	
Melaleuca thymoides		+					
Melaleuca trichophylla		+	+				
Verticordia pennigera				+			
Olacaceae							
Olax benthamiana		+					

Family/Scientific Name	Cr	Em	Ch/Em	Ew	El	D	CC
Oleaceae							
*Olea europaea		+				+	
Orchidaceae							
Caladenia flava subsp. flava		+	+		+		
Caladenia longicauda				+			
Caladenia macrostylis			+				
Caladenia reptans subsp. reptans		+	+				
Caladenia uliginosa subsp. patula			+				1
Cyanicula sericea		+					
*Disa bracteata				+	+		
Diuris corymbosa				+			
Elythranthera brunonis		+			+		
Elythranthera emarginata				+			
Eriochilus dilatatus				+			
Leporella fimbriata		+					
Microtis media			+	+			
Pterostylis vittata			+				
Pyrorchis nigricans		+	+				
Thelymitra benthamiana		+	+	+	+		
Thelymitra crinita		+	+	+	+		
Thelymitra vulgaris			+				
Ophioglossaceae							
Ophioglossum lusitanicum				+			
Orobanchaceae							
*Orobanche minor					+		
*Parentucellia latifolia					+		
*Parentucellia viscosa					+		
Philydraceae							
Philydrella pygmaea				+			
Phyllanthaceae							
Phyllanthus calycinus		+		+			
Poranthera microphylla		+					
Pittosporaceae							
Billardiera floribunda					+		
Billardiera venusta			+				
Marianthus candidus			+				
Marianthus tenuis		+			+		
Pronaya fraseri			+				
Plantaginaceae							
*Plantago lanceolata		+				+	

Family/Scientific Name	Cr	Em	Ch/Em	Ew	El	D	CC
Poaceae							
*Aira caryophyllea		+	+	+		+	
*Aira cupaniana					+		
Amphipogon turbinatus		+			+		
Austrostipa compressa		+					
Austrostipa campylachne		+	+	+	+		
Austrostipa semibarbata		+					
*Brachypodium distachyon		+	+			+	
*Briza maxima		+	+	+	+	+	
*Briza minor	+	+	+	+	+	+	
*Bromus diandrus			+		+	+	
*Bromus hordeaceus					+	+	
*Cynodon dactylon						+	
*Cynosurus echinatus				+			
Dichelachne crinita			+		+		
*Ehrharta calycina		+				+	
*Ehrharta longiflora			+			+	
*Eragrostis curvula						+	
*Holcus lanatus					+		
*Holcus setiger					+		
*Lolium rigidum					+	+	
Lachnagrostis plebeia					+		
Microlaena stipoides				+			
Neurachne alopecuroidea		+	+	+	+		
*Pennisetum clandestinum						+	
*Pentameris airoides					+		
Poa drummondiana				+	+		
Poa homomalla					+		
Rytidosperma occidentalis		+	+		+		
Rytidosperma setacea			+				
*Stenotaphrum secundatum						+	
Tetrarrhena laevis		+	+		+		
Themeda australis				+			
*Vulpia myuros				+		+	
Polygalaceae							
Comesperma calymega			+				
Comesperma virgatum		+	+		+		
Polygonaceae							
Muehlenbeckia adpressa			+				
Persicaria prostrata	+						
Primulaceae							
*Anagallis arvensis var. arvensis			+	+	+	+	
*Anagallis arvensis var. caerulea				+		+	

Family/Scientific Name	Cr	Em	Ch/Em	Ew	El	D	CC
Proteaceae							
Adenanthos meisneri		+	+				
Banksia attenuata			+				
Banksia grandis		+					
Banksia littoralis				+			
Dryandra armata			+		+		
Dryandra bipinnatifida subsp. multifida			+				
Dryandra lindleyana subsp. lindleyana		+	+	+	+		
Grevillea bipinnatifida subsp. bipinnatifida					+	+	
Grevillea quercifolia					+		
Grevillea wilsonii		+					
Hakea amplexicaulis		+	+		+		
Hakea cyclocarpa		+	+				
Hakea lissocarpha				+	+		
Hakea prostrata		+	+	+			
Hakea ruscifolia		+					
Hakea stenocarpa		+	+				
Isopogon sphaerocephalus		+	+				
Persoonia elliptica			+				
Persoonia longifolia		+	+				
Persoonia saccata			+				
Petrophile linearis		+	+				
Stirlingia latifolia			+				
Synaphea petiolaris subsp. petiolaris		+	+				
Synaphea petiolaris subsp. triloba					+		
Ranunculaceae							
Clematis linearifolia		+					
Clematis pubescens			+		+		
*Ranunculus muricatus				+	+		
Restionaceae							
Desmocladus asper				+			
Desmocladus fasciculatus		+	+				
Desmocladus flexuosus			+				
Hypolaena exsulca		+					
Hypolaena fastigiata				+			
Lepyrodia glauca				+			
Restio microcodon			+				
Rhamnaceae							
*Rhamnus alaternus						+	
Trymalium ledifolium		+					
Rubiaceae							
*Galium divaricatum			+		+	+	
Opercularia apiciflora		+	+	+	+		
Opercularia vaginata			+				

Family/Scientific Name	Cr	Em	Ch/Em	Ew	El	D	CC
Rutaceae							
Boronia crenulata				+	+		
Philotheca spicata		+	+		+		
Santalaceae							
Exocarpos sparteus		+					
Leptomeria cunninghamii					+		
Solanaceae							
*Solanum nigrum						+	
Stackhousiaceae							
Stackhousia pubescens					+		
Tripterococcus brunonis		+			+		
Stylidiaceae							
Levenhookia pusilla			+	+	+		
Levenhookia stipitata		+					
Stylidium amoenum var. amoenum		+	+				
Stylidium androsaceum		+	+		+		
Stylidium carnosum					+		
Stylidium ciliatum		+	+				
Stylidium crassifolium	+			+	+		
Stylidium eriopodum				+	+		
Stylidium junceum subsp. brevis					+		
Stylidium korijekup (Type locality)					+		2
Stylidium petiolare					+		
Stylidium plantagineum			+				
Stylidium piliferum		+			+		
Stylidium schoenoides		+					
Stylidium tenue		+					
Thymelaeaceae							
Pimelea imbricata var. imbricata				+			
Pimelea lehmanniana					+		
Pimelea suaveolens subsp. suaveolens	+						
Pimelea sylvestris			+				
Violaceae							
Hybanthus floribundus subsp. floribundus			+				
Xanthorrhoeaceae							
Xanthorrhoea acanthostachya		+	+				
Xanthorrhoea gracilis		+	+	+	+		
Xanthorrhoea preissii		+	+	+	+		

FLORA OF THE SWAN COASTAL PLAINS FOOTHILLS 4: VASCULAR FLORA OF THE YARLOOP TOWNSITE RESERVES

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ABSTRACT

The seven small reserves around Yarloop, south of Perth, have a vascular flora of 461 species (359 native species and 102 weeds), including *Billardiera venusta* (Pittosporaceae), a species only recorded for the Swan Coastal Plain Bioregion from this locality. This unique area is the largest remaining vegetated area of the sandy dunes formed when an ancient shoreline abutted the base of the Darling Scarp.

INTRODUCTION

The Foothills (Ridge Hill Shelf) of the Swan Coastal Plain IBRA region (Macarthur & Bettenay, 1960 and Department of Environment and Water Resources, 2007) are the gentle slopes of colluvial sands, loams and clays with intrusions of gravel that may be at surface or depth that derive from the Darling Plateau and abut the granitic slopes of the Darling Escarpment. The Foothills have very high levels of clearing for agriculture being of low relief, relatively fertile and better drained than the adjacent Pinjarra Plain. It is estimated that the Foothills are approximately 97% cleared, making any remnant of high regional conservation value. This is the fourth of a series of papers describing the vascular flora of the foothills (Keighery & Keighery, 2105, 2017 and 2018).

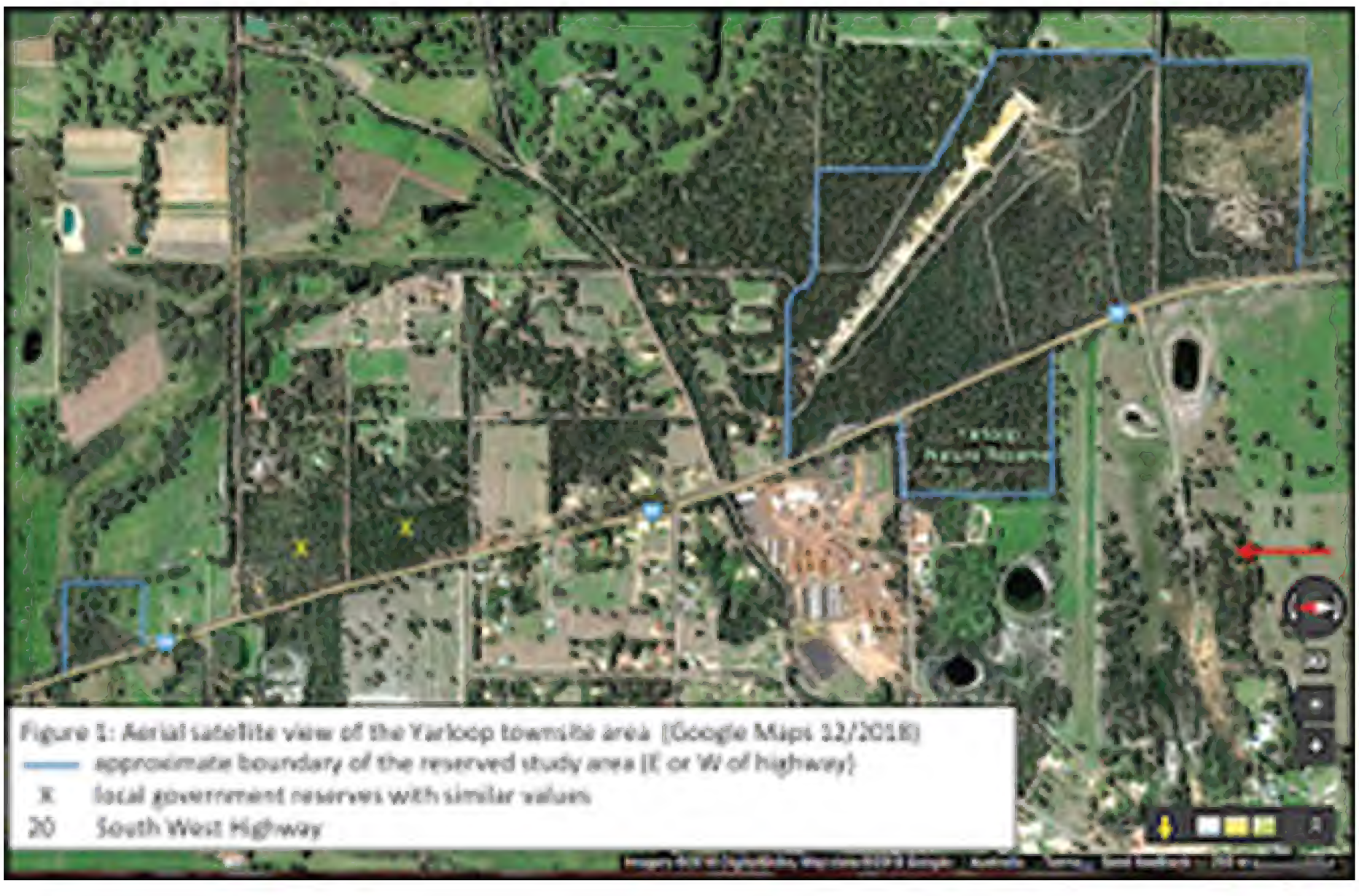
Like all of the above reserves, Bancell Road, Korijekup and Lambert Lane (Keighery & Keighery, 2015, 2017 and 2018), this very significant remnant was not mentioned in the System Six Report as of conservation significance (Department of Environment and Conservation, 1983). Fortunately when the area was proposed to be subdivided for housing, and mining, the then Planning Officer of the Central Forest Region of the

Department of Conservation and Land Management recognising the significance of the landform commissioned a report on the values of the area (Keighery, 1995), which also highlighted its significance. These actions began the process, which will lead to the declaration of all the governmental reserves into a Nature Reserve (EPA, 2000).

This paper describes the vegetation and vascular flora of a series of remnant bushland sites around Yarloop all of which are dominated by colluvial sands and laterites derived from the Darling Range (Figure 1). These include Reserve 22215 (1.5 ha, Drainage and Camping, Shire of Waroona) north of the town; Yarloop Town site reserves (Shire Reserve 31900, DOLA Reserves 3672, 16681, 23307 & 31901; c.80 ha. in total) and finally Reserve 47123 (approximately 9 ha. south of SW Highway, previously freehold). As noted previously, it was proposed in 2000 (EPA, 2000) that the majority of these reserves be amalgamated into Yarloop Nature Reserve (47123), however, in 2019 this action is still to occur!

SURVEY METHOD

Survey work has been conducted over several flowering seasons from 1994 to 2016. Four Floristic quadrats were established in the bushland in 1994 and others were established under the System Six update program (Department of Environmental Protection, 1996) and for the



Swan Bioplan Program (Department of Environment and Conservation, 2007). Records from these surveys were incorporated in the species list. Records for Reserve 31900 made under the mining proposal (Environmental Protection Authority, 2000) were also included. Opportunistic plant collections, that is, collections made outside set quadrats, were made during foot traverse at various times of the year over this period. Because of the severe localised disturbance only areas of relatively intact bushland were used to record species presence. Voucher collections are deposited in PERTH.

Nomenclature generally follows that used that used in FloraBase (Western Australian Herbarium 1998-), or in the most recent revisions. Conservation status of the flora is assigned in Smith (2017) as per Table 1.

GEOMORPHOLOGY AND SOILS

Macarthur & Bettenay (1960) map the area around the Yarloop town site as an area of interleaving Guildford formation and Yoganup formation of the Swan Coastal Plain. They map the town site reserves as Yoganup formation, which comprises the Ridge Hill Shelf System of the Swan Coastal Plain Biogeographic region (Department of Environment and Water Resources, 2007).

However, at the scale used it is difficult to ascertain if all of reserve 22215, which is a kilometre north of the town is Ridge Hill Shelf or an intergrade into the Guildford Formation. This area has Marri woodland with a *Melaleuca* dominated wetland over *Pericalymma* shrubland on clay soils, which is the typical vegetation of the Guildford formation. Also the flora contains both common and

Table 1. Categories of Conservation Listed Flora according to the degree of perceived threat

Category	Definition
P1 (Poorly known Flora)	Taxa with less than 5 populations, which are under threat
P2 (Poorly known Flora)	Taxa with less than 5 populations, at least some of which are not believed to be under immediate threat
P3 (Poorly known Flora)	Taxa with several populations (more than 5), at least some of which are not believed to be under immediate threat
P4 (Rare Taxa)	Taxa which are considered to be adequately surveyed and which while being rare are not currently threatened by any identifiable factors

rare species typical of the Pinjarra Plain.

Most of the southern Yarloop Reserves have a deep layer of grey/white sand over yellow sands with little apparent laterite present (Wilde & Walker, 1983).

VEGETATION

The vegetation is placed in the Forrestfield complex by Heddle *et al.*, (1980), which occurs along the foothills of the Darling Scarp. Beard (1981) placed the reserve in his Ridge Hill Shelf Subsystem, comprising Jarrah-Marri Forest with an understory tree layer of *Banksia grandis* and *Allocasuarina fraseriana.*

The Floristic Survey of the Swan Coastal Plain (Gibson *et al.*, 1994) placed four sites in the Yarloop reserves. These sites formed into a wide variety of groups mainly as part of Supergroup 1: Foothills and Pinjarra Plain, that is, communities of the eastern side of the Swan Coastal Plain.

Two quadrats aligned to Floristic Community type 3, most closely aligned to community 3b, which are Jarrah-Marri Woodlands on sandy clay soils (This floristic community type occurs generally on the Foothills between Cardup and Yarloop) or Community type 3c, which are Marri Woodlands over *Xanthorrhoea preissii* shrublands (Occurs mainly on the Foothills from Pearce to Yarloop, but extends onto the Pinjarra Plain near Bunbury).

The quadrat on the northern reserve 22215 aligned to Community type 9 which are dense shrublands on clay flats (This community type is found predominantly on the Pinjarra Plain, from Byford to Busselton).

The quadrat on the southern reserve aligned to Community type 20b, which are Eastern *Banksia attenuata* and/or *Eucalyptus marginata* woodlands (extending from Cardup to Yarloop) on sandy soils of the Foothills.

These communities are conservation listed at present and several (Type 3 and 9) and are proposed to be legally protected as Threatened Ecological Communities under the Biodiversity Conservation Act in 2019.

FLORA

Total Flora

A combined vascular flora list of 461 species (359 natives, 102 weeds) was recorded from the reserves (Table 2). These are listed under the reserves in which they have been recorded from north to south.

Species Richness

The most species rich families are the Asteraceae 37 species (14 weeds), Fabaceae 61 species (including 22 weeds), Poaceae 36 species (22 Weeds) and the Proteaceae 28 species. This is slightly unusual in not having the Asparagaceae 24 species (2 weeds), Myrtaceae (16, with 1

weed), Orchidaceae (26, with 1 weed) or Cyperaceae (27, with 1 weed) in the top four families. We are certain that this reflects past disturbance events, since the number of weeds changes the dominance of several families. Without the weeds it does reflect the normally most dominant families of the Southwest flora.

The most species rich genera are *Acacia* (11 species), *Hibbertia* (10) and *Lomandra* (10). The high diversity of *Lomandra* species is typical of the Jarrah forest on the western edge of the Darling Plateau, reflecting the mixed nature of the site. Also of interest are the 8 species of *Gompholobium* occurring in the reserves, a very diverse assemblage for this genus.

Significant Species

These are briefly described below.

Conservation Listed Species

The declared rare species, *Synaphea* sp. Serpentine occurs in the northern reserve. This species is found mainly in small roadside or rail verge populations along the eastern side of the Swan Coastal Plain between Mundijong and Elgin.

Another species with a similar distribution, but more common is the Priority 1 species, *Synaphea oedicolips*. Finally the rarely recorded Priority 2 species, *Cardamine paucijuga*, which ranges from Perth to Albany, was also recorded in the northern reserve.

Significant records

The population of *Billardiera venusta* is the only record of this species from the Swan Coastal Plain.

A population of *Scholtzia ciliata* (Myrtaceae) was recorded on the northern boundary of the Rifle Range. This record is in undisturbed bushland, and was considered when collected a native species, but is highly disjunct from the species' normal range between Geraldton and Northampton on clayey sands. A genetic study of this population is needed, to determine the status of this record.

A significant range extension of over 200 kilometres from Yanchep to Yarloop was also recorded for *Muehlenbeckia polybotrya* (Polygonaceae), which appeared on ash beds after the fire.

There are also 7 taxa found here that are only known from the Swan Coastal Plain from the Foothills (Keighery, 1999): *Bossiaea angustifolium*, *Chorizema rhombeum*, *Daviesia costata*, *Dryandra bipinnatifida* subsp. *multifida*, *Marianthus candidus*, *Marianthus tenuis*, and *Xanthorrhoea gracilis*.

Other species that are characteristic of the eastern side of the plain (*Grevillea wilsonii*,

Pentapeltis peltigera, *Gastrolobium dilatatum*, *Hakea cyclocarpa*, *Lechenaultia biloba*, *Persoonia elliptica*, and *Tribonanthes brachypetala*) are recorded in the reserves.

Weeds

Areas of the reserve and adjacent areas have been subject to gross disturbance, being totally cleared, used as a refuse tip, developed for active recreation, sand mined, logged and subjected to garden refuse dumping. Although many of these species are still confined to these very disturbed areas, some such as *Leptospermum laevigatum* and *Acacia longifolia* are spreading into the reserve and pose a future risk to the values of the reserve. Consolidation of the reserves for nature conservation and rehabilitation of the disturbed areas would greatly lessen the weed risk.

Scattered through the bushland the major weeds noted were annual and perennial grasses, **Avena barbata*, **Briza maxima*, **B. minor*, **Cenchrus clandestinus*, *Cynodon dactylon*, **Eragrostis curvula*, **Ehrharta calycina*, **Stenotaphrum secundatum* and **Tribolium uniolae*. Many of these grasses are ecosystem altering weeds that change fire regimes, smother native annuals and cover any bare areas needed by native fauna (Keighery & Longman, 2004). Other major weeds present in the reserve are the bulbous weeds **Freesia alba x leichtlinii* and *Watsonia meriana* var. *bulbillifera*, these compete with native orchids and many other native herbs.

DISCUSSION

As noted the Yarloop Reserves were apparently part of the ancient shoreline abutting the Darling Scarp that became the Yoganup Formation, where the action of waves and erosion created mineral sand deposits. A large heavy sand mine was proposed and subsequently developed in part of reserve 31900 (Cable Sands, 2000, EPA, 2000) which resulted in the clearing of 5.5 hectares of this reserve.

Despite reading all EPA annual reports since the mine was approved in 2000, those of Cabel Sands and Cristal Mining (which acquired Cable Sands) and considerable internet searching, it appears that no public review or scientific documentation exists to document what rehabilitation program was undertaken and what the completion criteria were. Currently, there appears to have been no active restoration activities for many years at the site. Although required to be fully rehabilitated after mining (EPA, 2000), the mined area remains in 2018, structurally and floristically impoverished with many weeds compared to the adjacent bushland.

We consider that over 90% of the known flora has been recorded. The reserves of the Yarloop Town site preserve the sandy phase of the Foothills formed by the old beach dunes formed along the base of the Darling Scarp. The Foothills retain the least native vegetation of any area of the Swan Coastal Plain and this well drained soil would

have been preferentially cleared for farms and infrastructure. The Yarloop Reserves are probably unique in conserving the last remnants of this soil type. Apparently at least part of the area (reserve 22215) may also be an intergrade to the Guildford formation of the Pinjarra Plain.

ACKNOWLEDGEMENTS

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Table 2. Yarloop Townsite Reserves

Columns: A: Reserve 22215 (North of town), B: Reserves 31900 etc. (East of Highway), C: Reserve 47123 (West of Highway), D: Disturbed.

Naturalised Name	A	B	C	D
Adiantaceae				
Cheilanthes austrotenuifolia	+			
Aizoaceae				
* Carpobrotus edulis	+			+
Amaranthaceae				
Ptilotus esquamatus	+			
Ptilotus stirlingii	+	+		
Amaryllidaceae				
* Leucojum aestivum				+
Aanarthriaceae				
Anarthria gracilis	+	+		
Asparagaceae				
* Asparagus asparagoides	+	+		
Arthropodium capillipes		+	+	
Borya scirpoidea	+			
Chamaescilla corymbosa var. corymbosa	+	+		+
* Hyacinthoides non-scripta				+
Laxmannia sessiliflora subsp. australis			+	
Lomandra brittanii	+			
Lomandra caespitosa	+	+	+	+
Lomandra hermaphrodita		+		
Lomandra micrantha		+		
Lomandra nigricans	+	+	+	
Lomandra preissii	+	+	+	+
Lomandra purpurea	+	+	+	
Lomandra sericea	+	+	+	
Lomandra sonderi		+		
Lomandra suaveolens		+	+	
Sowerbaea laxiflora		+		
Thysanotus dichotomus	+		+	
Thysanotus manglesianus	+		+	
Thysanotus multiflorus	+	+		
Thysanotus patersonii			+	
Thysanotus arbuscula		+		
Thysanotus sparteus	+	+	+	
Thysanotus thyrsoideus	+	+	+	+

	Naturalised Name	A	B	C	D
	Apiaceae				
	Actinotus glomeratus	+			
	Daucus glochidiatus	+	+	+	
	Eryngium pinnatifidum subsp. pinnatifidum		+		
*	Foeniculum vulgare				+
	Homalosciadium homalocarpum	+	+	+	
	Hydrocotyle alata	+			
	Hydrocotyle callicarpa		+		
	Hydrocotyle hispidula		+		
	Hydrocotyle pilulifera	+			
	Pentapeltis peltigera	+	+	+	
	Trachymene pilosa	+	+	+	+
	Xanthosia candida	+	+		
	Xanthosia ciliata		+		
	Xanthosia huegelii	+	+	+	
	Asteraceae				
*	Arctotheca calendula	+	+	+	+
	Asteridea pulverulenta	+	+	+	
	Brachycome iberidifolia		+		
*	Cirsium vulgare	+		+	+
*	Conyza bonariensis	+			+
*	Conyza sumatrensis	+			+
	Cotula australis	+			+
*	Cotula turbinata	+	+	+	+
	Craspedia variabilis		+		
*	Dimorphotheca ecklonis				+
	Euchiton sphaericum	+	+		
*	Helipterum luteo-album	+	+	+	+
	Hyalospermum cotula	+	+		
*	Hypochaeris glabra	+	+	+	+
*	Lactuca saligna	+	+	+	+
	Lagenifera huegelii	+	+	+	+
*	Logfia gallica	*			+
	Millotia tenuifolia	+	+		
*	Monoculus monstrosus				+
	Myriocephalus occidentalis	+			
	Olearia paucidentata		+		
	Podolepis gracilis		+		
	Podolepis lessonii	+			
	Podotheca angustifolia	+	+		
	Pterochaeta paniculata	+	+		
	Quinetia urvillei		+		
	Rhodanthe citrina	+	+		
	Senecio multicaulis subsp. multicaulis	+	+		
	Senecio quadridentatus	+	+		
	Siloxerus filifolius	+	+		

Naturalised Name	A	B	C	D
Siloxerus humifusus	+	+		
Siloxerus multiflorus	+			
* Sonchus oleraceus	+	+	+	+
Trichocline spathulata		+	+	
* Ursinia anthemoides	+	+	+	+
* Vellereophyton dealbatum	+	+		
Waitzia suaveolens	+	+		
Campanulaceae				
* Wahlenbergia capensis	+	+	+	+
Wahlenbergia preissii		+	+	
Brassicaceae				
Cardamine paucijuga	+	+	+	
Caryophyllaceae				
* Cerastium glomeratum		+	+	+
* Petrorhagia velutina	+	+	+	+
* Silene gallica var. gallica	+	+	+	+
* Silene nocturna		+	+	+
* Spergula arvensis		+		+
* Stellaria media		+		+
Casuarinaceae				
Allocasuarina fraseriana		+	+	
Allocasuarina humilis		+		
Centrolepidaceae				
Aphelia cyperoides	+			
Centrolepis aristata	+			
Centrolepis drummondiana	+	+		
Clusiaceae				
Hypericum japonicum	+			
Colchicaceae				
Burchardia congesta	+	+	+	
Burchardia multiflora	+			
Crassulaceae				
Crassula colorata var. tuberculata	+	+		
* Crassula natans var. minus	+			
Crassula peduncularis	+			
Cuscutaceae				
* Cuscuta epithymum	+			

Naturalised Name	A	B	C	D
Cyperaceae				
Chorizandra enodis	+			
Cyathochaeta avenacea	+	+		
Cyathochaeta equitans	+			
* Cyperus tenellus	+	+		
Isolepis cernua	+			
Isolepis cyperoides	+			
Isolepis marginata	+	+	+	
Isolepis oldfieldiana	+			
Isolepis setiformis	+			
Lepidosperma gracile				
Lepidosperma leptostachyum	+	+		
Lepidosperma scabrum	+	+		
Lepidosperma squamatum	+	+		
Lepidosperma tenue				
Mesomelaena graciliceps	+	+		
Mesomelaena tetragona	+	+		
Schoenus asperocarpus	+			
Schoenus brevisetis	+	+		
Schoenus curvifolius	+	+		
Schoenus discifer	+			
Schoenus odontocarpus	+			
Schoenus efoliatus		+		
Schoenus sp. (GK 5739)	+			
Schoenus subbarbatus	+			
Schoenus unispiculatus	+			
Tetraria capillaris	+	+	+	
Tetraria octandra	+	+	+	
Dasypogonaceae				
Calectasia narragara		+		
Dasypogon bromeliifolius		+		
Dilleniaceae				
Hibbertia acerosa		+		
Hibbertia amplexicaulis		+		
Hibbertia cunninghamii	+	+		
Hibbertia ferruginea		+		
Hibbertia huegelii		+		
Hibbertia hypericoides	+	+	+	
Hibbertia mylnei		+		
Hibbertia racemosa	+			
Hibbertia subvaginata	+	+		
Hibbertia vaginata	+	+		
Droseraceae				
Drosera erythrorhiza	+	+	+	
Drosera gigantea subsp. gigantea	+			

	Naturalised Name	A	B	C	D
	Drosera glanduligera	+	+		
	Drosera macrantha	+	+		
	Drosera menziesii subsp. penicillaris	+			
	Drosera paleacea subsp. paleacea		+		
	Drosera pallida		+		
	Drosera porrecta	+	+		
	Ericaceae				
	Andersonia sprengelioides				
	Astroloma ciliatum	+	+		
	Astroloma pallidum	+	+	+	
	Conostephium pendulum		+		
	Conostephium preissii				
	Leucopogon capitellatus				
	Leucopogon pulchellus				
	Lysinema ciliatum				
	Styphelia tenuiflora	+	+		
	Euphorbiaceae				
	Monotaxis occidentalis		+		
	Phyllanthus calycinus		+	+	
	Poranthera microphylla	+	+	+	
	Stachystemon vermicularis		+		
		+			
	Fabaceae				
	Acacia alata	+			
	Acacia applanata	+	+		
	Acacia extensa				
	Acacia huegelii		+		
*	Acacia longifolia	+			
	Acacia preissiana		+		
	Acacia pulchella var. glaberrima	+	+	+	
*	Acacia pycnantha	+			
	Acacia saligna	+	+		+
	Acacia sessilis		+		
	Acacia stenoptera		+		
	Aotus procumbens		+		
	Bossiaea angustifolia		+	+	
	Bossiaea eriocarpa	+	+		
*	Chamaecytisus palmensis		+		+
	Chorizema rhombeum	+	+		
	Daviesia costata		+		
	Daviesia decurrens		+		
	Daviesia divaricata		+		
	Daviesia physodes	+	+		
	Daviesia preissii	+	+		
*	Dipogon lignosus	+			
	Gastrolobium capitatum	+			

	Naturalised Name	A	B	C	D
	Gompholobium aristatum	+	+		
	Gompholobium knightianum	+	+		
	Gompholobium marginatum	+	+	+	
	Gompholobium ovatum		+		
	Gompholobium polymorphum	+			
	Gompholobium preissii	+	+	+	
	Gompholobium shuttleworthii		+		
	Hovea trisperma subsp. grandiflora	+	+		
	Hovea trisperma subsp. trisperma		+		
	Isotropis cuneifolia subsp. cuneifolia	?	+		
	Jacksonia furcellata		+		
	Jacksonia lehmannii	+	+		
	Jacksonia sternbergiana	+	+		
	Kennedia coccinea subsp. coccinea	+	+		
	Kennedia prostrata	+	+	+	
	Labichea punctata		+		
*	Lathyrus tingitanus		+		+
*	Lotus angustissimus	+	+		
*	Lupinus angustifolius	+			+
*	Lupinus cosentinii		+		+
*	Lupinus luteus				+
*	Medicago polymorpha	+			+
*	Melilotus indica				+
*	Ornithopus compressus	+	+	+	+
*	Ornithopus sativus				+
	Sphaerolobium linophyllum	+			
	Sphaerolobium medium	+			
*	Trifolium angustifolium	+	+		+
*	Trifolium arvense	+	+		+
*	Trifolium campestre		+		+
*	Trifolium cernuum	+			+
*	Trifolium glomeratum	=			+
*	Trifolium hirtum		+		+
*	Trifolium incarnatum var. incarnatum				+
*	Trifolium repens	+	+		+
*	Vicia sativa				+
	Viminaria juncea	+			
	Gentianaceae				
*	Centaurium erythraea	+			+
*	Cicendia filiformis	+			
	Geraniaceae				
	Geranium retrorsum	+	+	+	
	Pelargonium littorale	+		+	
	Goodeniaceae				
	Dampiera alata	+			

Naturalised Name	A	B	C	D
Dampiera linearis	+	+		
Goodenia caerulea	+			
Goodenia incana	+			
Lechenaultia biloba		+		
Lechenaultia floribunda		+		
Scaevola phlebopetala	+	+	+	
Scaevola repens	+	+		
Haemodoraceae				
Anigozanthos humilis		+		
Anigozanthos humilis x manglesii		+		
Anigozanthos manglesii	+	+		
Anigozanthos manglesii x viridis	+			
Anigozanthos viridis	+			
Conostylis aculeata	+		+	
Conostylis juncea		+		
Conostylis serrulata		+		
Conostylis setigera subsp. setigera		+		
Haemodorum laxum	+	+	+	
Haemodorum sparsiflorum	+			
Haemodorum spicatum	+	+	+	
Phlebocarya ciliata		+		
Phlebocarya filifolia		+		
Tribonanthes australis	+			
Tribonanthes brachypetala	+			
Haloragaceae				
Glischrocaryon aureum		+		
Gonocarpus benthamii		+		
Hemerocallidaceae				
Agrostocrinum hirsutum		+		
Agrostocrinum scabrum	+			
Caesia micrantha	+	+	+	+
Caesia occidentalis	+	+	+	
Dianella revoluta var. revoluta		+		
Stypandra glauca		+		
Tricoryne elatior		+	+	+
Tricoryne humilis	+	+	+	
Tricoryne tenella	+			
Hypericaceae				
Hypericum japonicum	+			
Hypoxidaceae				
Hypoxis glabella var. glabella	+			

Naturalised Name	A	B	C	D
Iridaceae				
* Freesia alba x leichtlinii		+		+
* Gladiolus angustus			+	
* Ixia maculata				+
* Moraea flaccida	+	+	+	+
Orthrosanthus laxus var. laxus		+		
Patersonia juncea	+	+	+	
Patersonia occidentalis var. occidentalis	+	+	+	
* Romulea rosea	+	+	+	+
* Watsonia meriana var. bulbillifera	+	+	+	+
Juncaceae				
* Juncus bufonius	+			+
* Juncus capitatus	+			+
Juncus pallidus	+			
Juncus subsecundus	+			
Luzula meridionalis		+		
Lamiaceae				
Hemiandra pungens var. pungens		+		
Hemigenia incana	+			
* Lavandula stoechadis		+		+
Lauraceae				
Cassytha glabella	+	+		
Cassytha racemosa		+		
Lobeliaceae				
Isotoma hypocrateriformis	+			
Lobelia tenuior	+	+		
Lobelia rhombifolia	+	+	+	
* Monopsis debilis	+			
Loganiaceae				
Logania serpyllifolia subsp. angustifolia		+	+	
Phyllangium paradoxum		+		
Loranthaceae				
Nuytsia floribunda		+	+	
Molluginaceae				
Macarthuria apetala		+		
Myrtaceae				
Babingtonia camphorosmae				
Calothamnus ?quadrifidus	+			
Corymbia calophylla	+	+		+
Eucalyptus marginata	+	+	+	+

	Naturalised Name	A	B	C	D
	Hypocalymma robustum				
	Kunzea glabrescens			+	
*	Leptospermum laevigatum	+	+		
	Melaleuca incana	+			
	Melaleuca rhaphiophylla	+			
	Melaleuca thymoides			+	
	Melaleuca preissiana	+			
	Scholtzia ciliata		+		
	Pericalymma elliptica	+			
	Olacaceae				
	Olax benthamiana			+	
	Orchidaceae				
	Caladenia arenicola		+		
	Caladenia discoidea		+		
	Caladenia flava subsp. flava	+	+	+	
	Caladenia splendens	+			
	Caladenia macrostylis	+	+		
	Caladenia hirta subsp. hirta		+		
	Caladenia longiclavata	+	+		
	Caladenia nana subsp. nana		+		
	Caladenia paludosa	+			
	Cyanicula sericea		+		
*	Disa bracteata	+	+	+	+
	Diuris corymbosa		+		
	Drakaea elastica		+		
	Elythranthera brunonis	+	+	+	
	Elythranthera emarginata				
	Eriochilus dilatatus	+			
	Leporella fimbriata		+		
	Microtis media	+	+		
	Prasophyllum elatum		+		
	Prasophyllum parviflorum		+		
	Pterostylis recurva		+		
	Pterostylis vittata	+	+		
	Pyrorchis nigricans	+	+	+	
	Thelymitra benthamiana	+		+	
	Thelymitra crinita		+		
	Thelymitra vulgaris	+			
	Orobanchaceae				
*	Orobanche minor	+	+		+
	Oxalidaceae				
	Oxalis exilis			+	
*	Oxalis glabra	+		+	+
*	Oxalis pes-caprae				+
*	Oxalis purpurea	+	+	+	+

Naturalised Name	A	B	C	D
Philydraceae				
Philydrella pygmaea	+			
Pittosporaceae				
Billardiera venusta				
Marianthus candidus				
Marianthus tenuis				
Pronaya fraseri	+	+		
Plantaginaceae				
* Plantago lanceolata	+			+
Poaceae				
* Aira caryophyllea	+	+	+	+
* Avena barbata	+	+	+	+
Amphipogon laguroides		+		
Amphipogon turbinatus		+		
* Anthoxanthum odoratum	+	+		+
Austrostipa campylachne	+	+	+	
Austrostipa compressa	+	+	+	
Austrostipa flavescens		+		
Austrostipa semibarbata	+	+	+	
* Briza maxima	+	+	+	+
* Briza minor	+	+	+	+
* Bromus diandrus			+	+
* Cenchrus clandestinum		+		+
* Cynodon dactylon		+		+
Dichelachne crinita		+		
* Ehrharta calycina	+	+	+	
* Ehrharta longiflora	+	+	+	+
* Eragrostis curvula	+	+		+
* Holcus lanatus				+
* Hordeum leporinum		+		+
* Lagurus ovatus		+	+	+
* Lolium rigidum	+	+	+	+
Lachnagrostis filiformis	+			
Microlaena stipoides	+			
Neurachne alopecuroidea	+	+	+	
* Phalaris aquatica	+			+
Poa drummondiana		+		
* Poa annua	+			+
* Polypogon monspeliensis	+			+
Rytidosperma occidentalis	+	+	+	
Rytidosperma setacea				
* Stenotaphrum secundatum		+		+
Tetrarrhena laevis	+	+	+	
* Tribolium uniolae	+			

Naturalised Name	A	B	C	D
* Vulpia bromoides	+			+
* Vulpia myuros	+	+	+	+
Polygalaceae				
Comesperma calymega	+	+		
Comesperma virgatum		+		
Polygonaceae				
Muehlenbeckia polybotrya		+		
Persicaria prostrata	+			
* Polygonum arenastrum				+
* Rumex crispus		+		
Portulacaceae				
Calandrinia corrigioloides	+	+		
Calandrinia granulifera		+		
Primulaceae				
* Anagallis arvensis var. arvensis	+	+		+
* Anagallis arvensis var. caerulea		+		+
Proteaceae				
Adenanthos meisneri	+	+		
Banksia attenuata	+	+		
Banksia grandis		+	+	
Banksia littoralis				
Conospermum stoechadis subsp. stoechadis	+	+	+	
Dryandra armata	+	+		
Dryandra bipinnatifida subsp. multifida		+		
Dryandra lindleyana subsp. lindleyana		+	+	
Grevillea bipinnatifida subsp. bipinnatifida	+			
Grevillea quercifolia		+		
Grevillea wilsonii		+		
Hakea amplexicaulis				
Hakea cyclocarpa	+	+		
Hakea lissocarpha				
Hakea prostrata	+	+		
Hakea ruscifolia		+		
Hakea stenocarpa				
Hakea sulcata	+	+		
Isopogon sphaerocephalus				
Persoonia elliptica	+	+		
Persoonia longifolia				
Persoonia saccata		+		
Petrophile linearis		+		
Stirlingia latifolia	+	+		

Naturalised Name	A	B	C	D
Synaphea odocoileops	+			
Synaphea petiolaris subsp. petiolaris				
Synaphea sp. Serpentine (J. Brand 103)	+			
Xylomelum occidentale		+		
Ranunculaceae				
Clematis linearifolia			+	
Clematis pubescens	+	+		
* Ranunculus muricatus				+
Restionaceae				
Chordifex sinuous	+	+		
Desmocladus asper	+			
Desmocladus fasciculatus	+	+		
Desmocladus flexuosus		+		
Hypolaena exsulca	+	+		
Hypolaena fastigiata				
Lepyrodia glauca	+			
Lyginia barbata	+	+		
Meeboldina co-angustata	+	+		
Rhamnaceae				
Trymalium ledifolium				
Rubiaceae				
* Galium divaricatum		+		+
Opercularia apiciflora	+	+	+	
Opercularia hispidula	+	+	+	
Opercularia vaginata		+		
Rutaceae				
Boronia crenulata		+		
Philotheca spicata		+		
Santalaceae				
Exocarpos sparteus				
Leptomeria cunninghamii				
Scrophulariaceae				
* Parentucellia latifolia				+
* Parentucellia viscosa				+
Selaginellaceae				
Selaginella gracillima	+			

Naturalised Name	A	B	C	D
Solanaceae				
* Solanum nigrum	+	+		+
Stackhousiaceae				
Stackhousia pubescens	+			
Tripterococcus brunonis		+		
Sterculiaceae				
Stylidiaceae				
Levenhookia pusilla	+	+		
Levenhookia stipitata		+	+	
Stylidium androsaceum	+	+	+	
Stylidium calcaratum	+			
Stylidium ciliatum	+	+	+	
Stylidium araeophyllum	+	+		
Stylidium hispidum		+		
Stylidium petiolare	+			
Stylidium piliferum		+		
Stylidium repens		+		
Stylidium schoenoides		+		
Thymelaeaceae				
Pimelea suaveolens subsp. suaveolens		+		
Pimelea sylvestris				
Tremandraceae				
Platytheca galioides		+		
Tetratheca hirsuta		+		
Valerianaceae				
* Centranthus macrosiphon		+	+	
Violaceae				
Hybanthus floribundus subsp. floribundus		+	+	
Xanthorrhoeaceae				
Xanthorrhoea gracilis	+	+	+	+
Xanthorrhoea preissii	+	+	+	+
Zamiaceae				
Macrozamia fraseri		+	+	

AN UNUSUALLY COLOURED TIGER SNAKE, *NOTECHIS SCUTATUS* (ELAPIDAE) FROM HERDSMAN LAKE, WESTERN AUSTRALIA

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Western Australian Tiger Snakes tend to be somewhat conservative in colouration, generally being described as "Upper surface black or dark brown, often with paler narrow bands. Lower surface yellow or orange..." (Storr *et al.* 2002, p. 192). They seem to lack the variation in colour and pattern shown by Tiger Snakes elsewhere in Australia (see Fearn 2014; Mirtschin *et al.* 2017). It was with some interest then, that on 26 August 2018 I encountered an unusually coloured Tiger Snake at Herdsman Lake (31°55'44"S, 115°48'19"E) in metropolitan Perth.

The snake appeared to have been basking when I unwittingly disturbed it: my attention being drawn by its sudden movement – flattening its neck and forebody in reaction to my presence. Thus, I had only a brief time in which to observe and photograph it before it took cover.

Figure 1. An unusually coloured Tiger Snake from Herdsman Lake. The dorsum is a uniform mid-brown and the flanks a pale cream colour.

Consequently the few photographs I took were via the camera on my mobile phone and of rather poor quality (Figure 1).

The snake was an adult, approximately 90 cm in total length. Its dorsal colouration was a uniform mid-brown. The lower flanks were a pale cream colour. There was no indication of banding; the contact zone between the two colours had a mottled appearance (individual brown scales over a cream background).

I have been visiting Herdsman Lake to observe Tiger Snakes for over fourteen years and this is the first time I have noted such a distinctive colour variation. Subsequent visits to the same immediate area for further photographs have failed to relocate this individual.

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EVIDENCE OF PLASTIC CONSUMPTION BY A TIGER SNAKE (*NOTECHIS SCUTATUS*) FROM A HIGHLY URBANISED WETLAND

By DAMIAN LETTOOF and KATHERINE ORTON

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On November 7, 2001 a female Tiger Snake (*Notechis scutatus*) was collected by Phil Stone as dead on the road alongside Herdsman Lake, Western Australia, and donated as a specimen to the Western Australian Museum. In September 2018 the specimen was examined and then dissected as part of a research project.

The snake was in a noticeably poor condition; measuring 602mm in length (snout to vent), emaciated and suffering tail loss, with only 48mm of its tail remaining. Tail loss is common for Tiger Snakes in urban wetlands but currently this phenomenon is poorly understood (Aubret *et al.* 2005). The snake's stomach bulged from an obvious nematode infestation and a second abnormal bulging was noticed at the end of its digestive tract. There was a small exit wound about one centimetre from the

Figure 1. Plastic protruding from tiger snakes body cavity.

Figure 2. Half a plastic bottle cap being removed from the lower end of the snake's digestive track.

cloaca with what appeared to be hard plastic protruding from the body (Fig. 1).

During dissection of the digestive tract the protrusion was found to be a much larger piece of hard plastic, what appeared to be half a bottle cap (Fig. 2). Presumably the bottle cap had made its way through the snake's entire digestive system until reaching the point at which it was wider than the snake's body cavity and could not be passed. We deduced that the pressure from the muscles and digestive system forced the inflexible and artificially shaped foreign item by its hard corner out through the body cavity. The organs around the bottle cap appeared to be heavily damaged, it is unlikely the snake could have passed any waste from this blockage.

Snakes are known to eat foreign non-prey items although throughout scientific literature this is not a commonly documented occurrence. A wild King Cobra (*Ophiophagus hannah*) died after ingesting a plastic bag (Strine *et al.* 2014) and a deceased wild Lesser Black Whip Snake (*Demansia vestigiata*) was found to have a foam ear plug in its

stomach (Charlton 2019). Over the last three years in Australia the media has documented snakes eating many foreign items such as a slipper, tennis ball and a teddy bear (ABC News, 2018; news.com.au, 2018; Telegraph.co.uk, 2018). It is presumed that snakes mistake these items as prey if the items are covered in the scent of the prey species (Stopford 1980), or by accidently consuming the item with adjoined prey. Although we are sceptical that a bottle cap could have been covered in enough frog scent to entice the tiger snake into eating it, this seems to be the most logical theory. An alternate hypothesis is that a large frog such as *Litoria moorei* or *Limnodynastes dorsalis* has accidentally eaten the bottle cap prior to being consumed by the snake. Although this seems unlikely considering the snakes' size, it was presumably too small to eat a frog large enough to swallow a bottle cap. As far as we are aware this is the first record of a tiger snake eating plastic.

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(Journal of the W.A. Naturalists' Club)

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